CIVIL ENGINEERING

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CIVIL
ENGINEERS
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1852

PROGRAM • CHICAGO CONVENTION • FEB. 24-28

BENCH DRILLING FOR BIG SWEDISH TAILRACE TUNNEL. SEE ARTICLE BY TORE NILSSON

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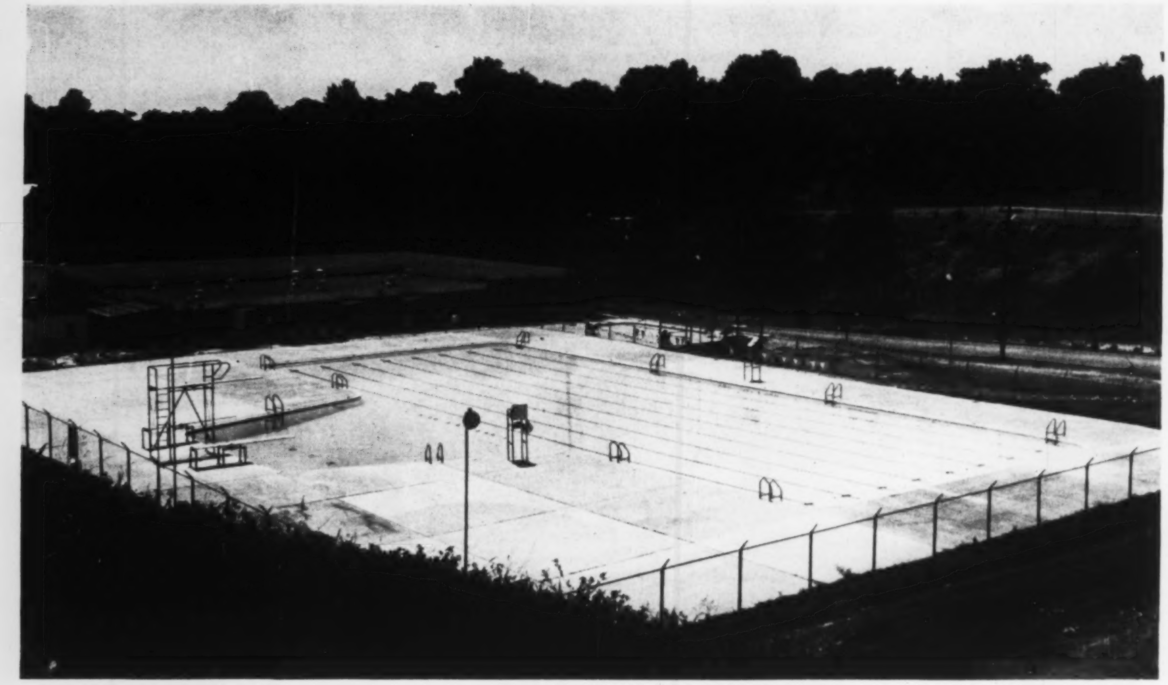
America's Finest Engineered Pool



PRESTRESSED, PRECAST CONCRETE UNITS SAVE LABOR COSTS

NATIONAL prestressed pool packages are available in all sizes from 16 x 32 up to any desired dimension for private and public pools. NATIONAL pools are approved by State Board of Health, and are designed to withstand forces caused by freezing in cold climates.

NATIONAL manufactures a complete line of superior equipment—underwater lights, vacuum cleaners, filters, etc. We retain a highly specialized engineering staff. Services of our staff are available, if desired, to all engineers and architects.

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- ☐ EQUIPMENT
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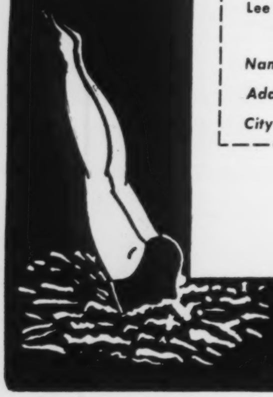

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MADISONVILLE, KENTUCKY, is so efficiently managed that for the third successive year no property taxes were levied. With this record for efficiency, it is only natural that corrosion-proof Clay Pipe was chosen for the city's new sewerage expansion program. More than twenty-two and a half miles of Vitrified Clay Pipe are going into the project.

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Consulting Engineers: J. Sanders Parker; F. E. Stepp, *Resident Engineer.*

Contractors: C. F. W. Construction Co., Inc.; Sterrett Construction Co.

C-458-1

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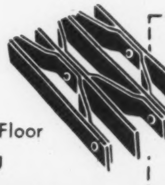

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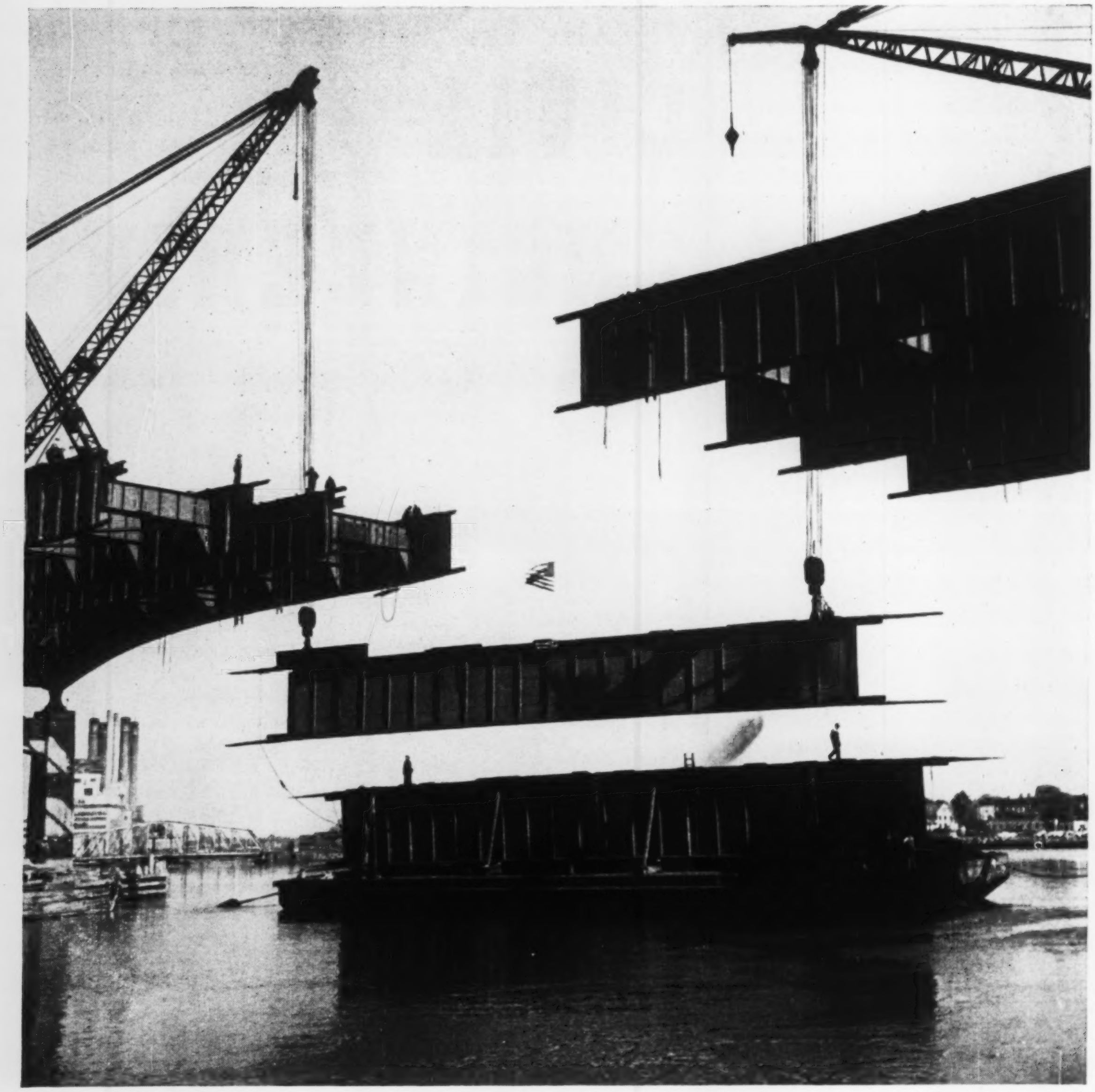

Up it goes!

The scene: New Haven harbor. The occasion: closing what is probably the longest continuous plate-girder span in the United States. The center girders measure 107 ft and the anchor arms 140 ft, for an impressive total length of 387 ft.

The operation shown here was a ticklish job, but it went off without a hitch. Two big travelers hoisted the four 89-ton girders and eased them into place about 65 ft above the channel. This closed the last gap in the 3,769-ft Quinnipiac River Bridge, longest elevated structure on the 192-mi Connecticut Turnpike.

While the bridge also includes beam and simple girder spans, of primary interest is the 906-ft continuous girder section over water. This portion required 3,600 tons of the 11,420 tons of fabricated steel used in the bridge.

The turnpike is a project of the Connecticut Turnpike Commission. D. B. Steinman designed the Quinnipiac River Bridge, and Bethlehem Steel Company was general contractor for the superstructure.

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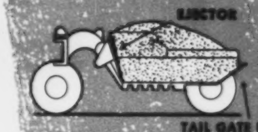
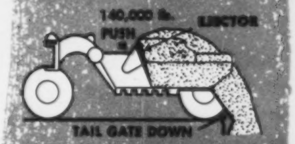
▲ Three of a fleet of ten Yuba Movalls stripping coal overburden at Huntley, New Zealand. These 32-ton capacity units are powered by AC T-360 prime movers.

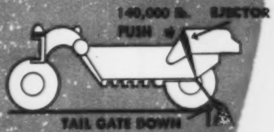
Two 32-ton Yuba Movalls replaced five conventional heavy-duty end dumps on a 5 mile section of Massachusetts Turnpike involving movement of 2,725,000 yards of rock and earth. These are powered by Cat DW-21s.



LOADED—The big target, big capacity body carries its load low, maintaining high ground clearance since frame and body are integral and compact.



DUMPING—Level body offers no gravity resistance, with potential 140,000 lb. ejector push assuring complete positive discharge with minimum use of power.



EMPTY—Sides and bottom are scraped clean, eliminating need for "mucking out" or decreasing capacity for next full load. Complete ejection takes only 11 to 14 seconds.

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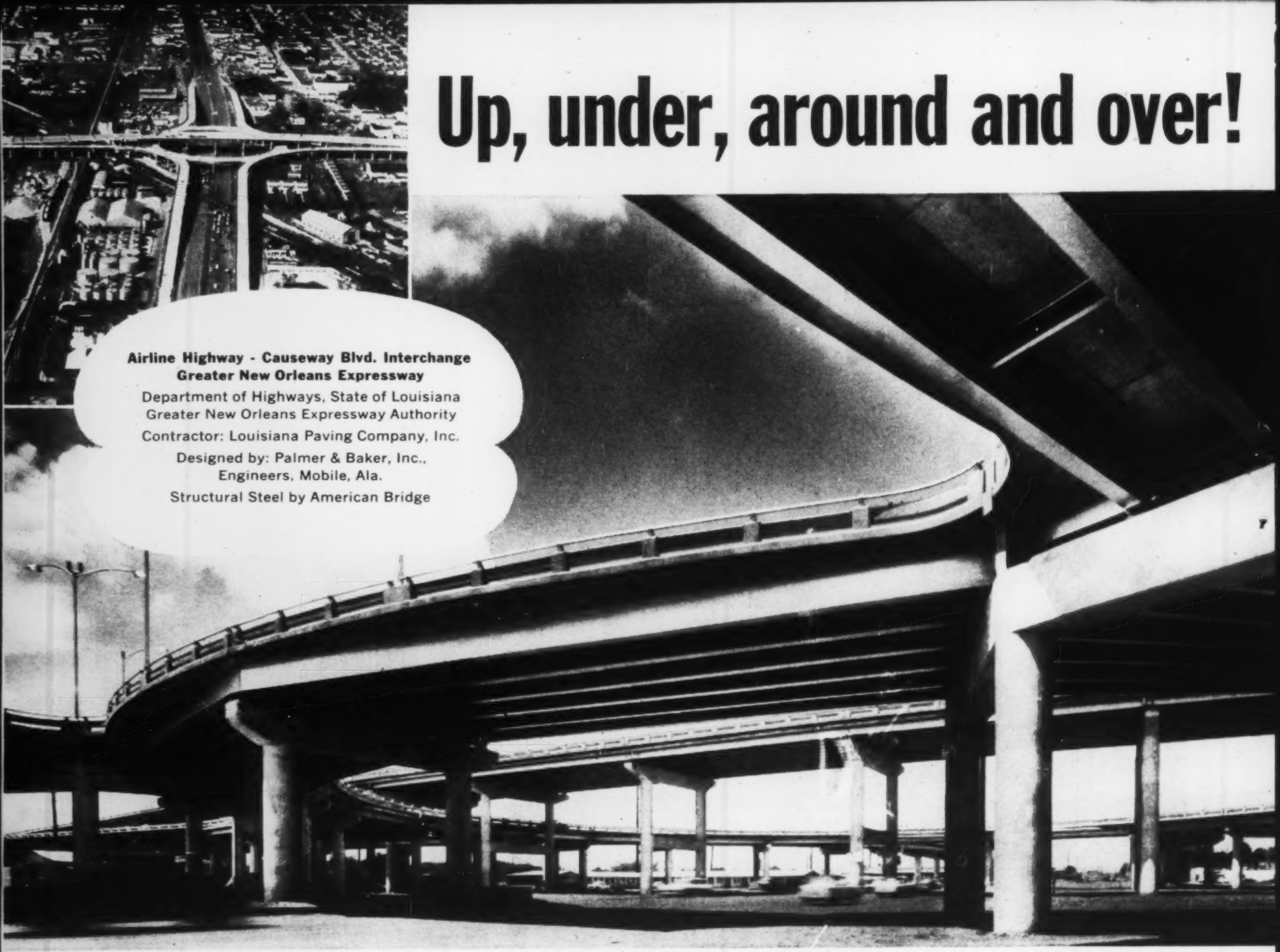

Up, under, around and over!

Airline Highway - Causeway Blvd. Interchange
Greater New Orleans Expressway
Department of Highways, State of Louisiana
Greater New Orleans Expressway Authority
Contractor: Louisiana Paving Company, Inc.
Designed by: Palmer & Baker, Inc., Engineers, Mobile, Ala.
Structural Steel by American Bridge

Interchange with elevated rotary roadway eliminates bottleneck at busy intersection . . . *speeds expressway traffic*

The bold new elevated rotary interchange shown above was recently opened on the Greater New Orleans Expressway. Designed to provide a maximum number of turning movements, it is already proving an efficient way to tie-in important intersecting highways with high-speed expressways . . . especially in built-up, congested areas.

Located at the busy intersection of Causeway Boulevard (the Expressway)—the only clear north-south route, and Airline Highway—a principal east-west route, this interesting circular interchange feeds traffic to and from these important arteries smoothly and with a minimum of interruptions.

The interchange embraces a 1,109′ long x 32′ wide circular elevated roadway having a 353′ centerline diameter. The Causeway Boulevard overpass over Airline Highway is 3,693′ long and carries two 28′ roadways plus median strip and walkways. Four 22′ ramps connect to Airline Highway, and four connect to the overpass, for a total of 7,590′ of ramp approaches. Altogether, interchange circle, overpass and ramps have about 2½ miles of roadway!

• • •

A total of 6,188 tons of structural steel went into the overpass, traffic circle and ramps. All of it was fabricated and erected by American Bridge.

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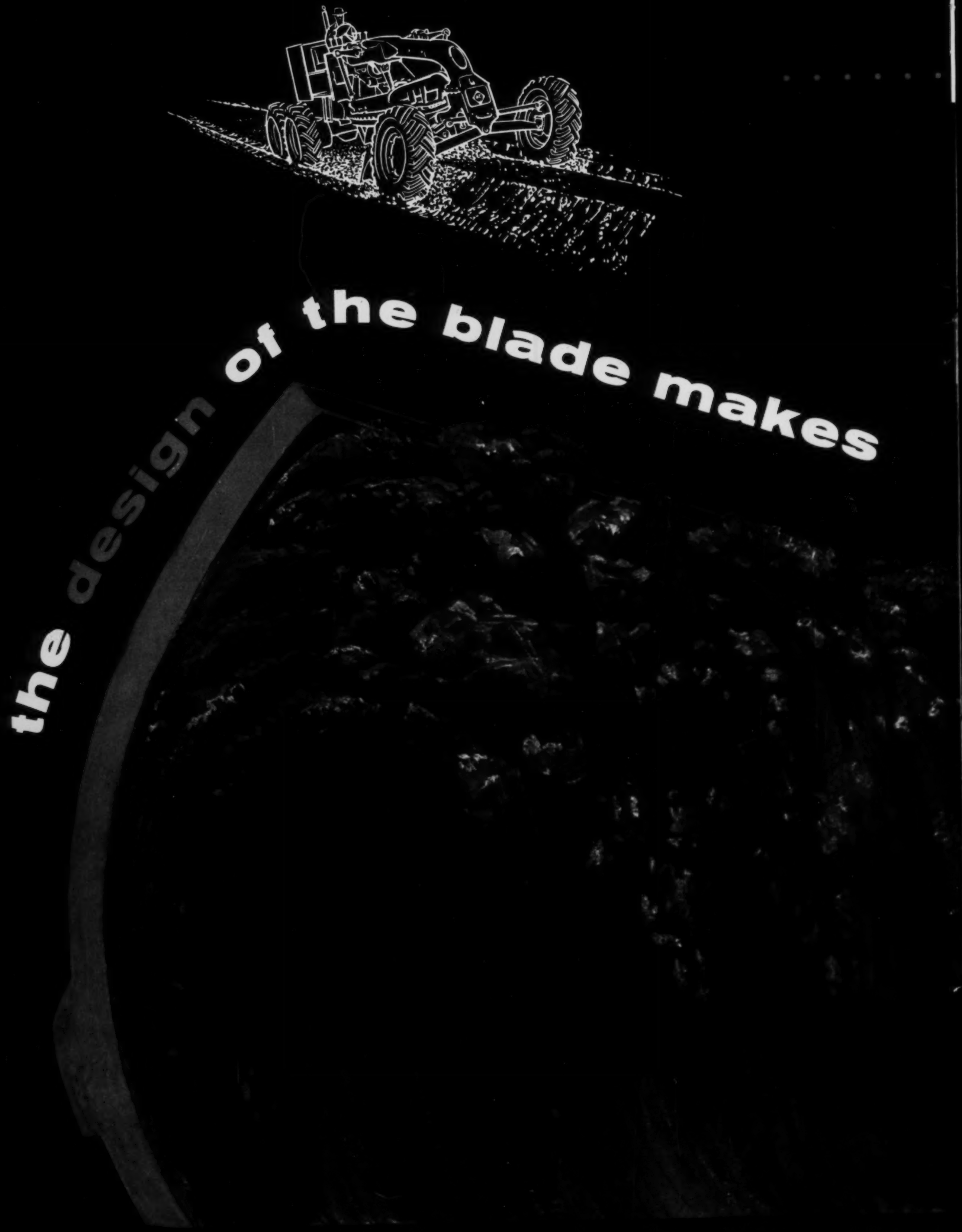
the design of the blade makes

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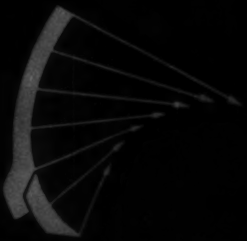
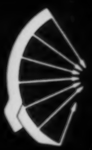
THE ROLL-AWAY MOLDBOARD MOVES BIG LOADS FASTER



Each portion of blade forces material toward a *different* point. Packing is eliminated. Pressure and friction against blade decreases toward top of blade — no wasted power.

ORDINARY MOLDBOARD



Each portion of blade forces material toward a *fixed* point. Packing action causes high friction over entire blade — wastes power.

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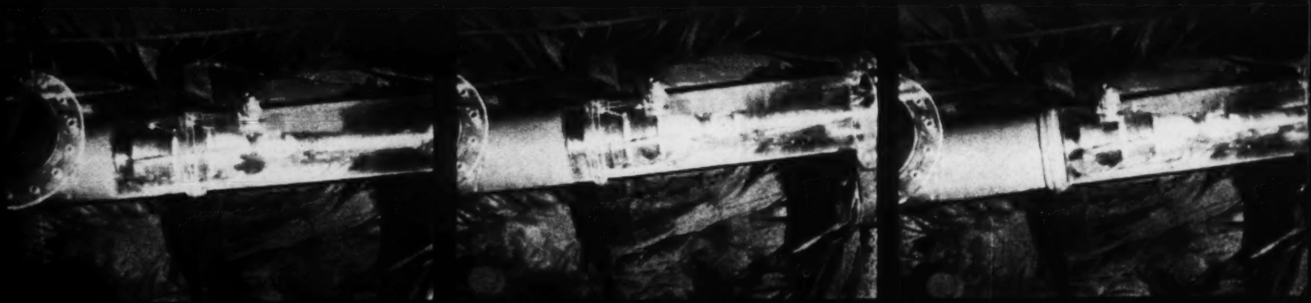
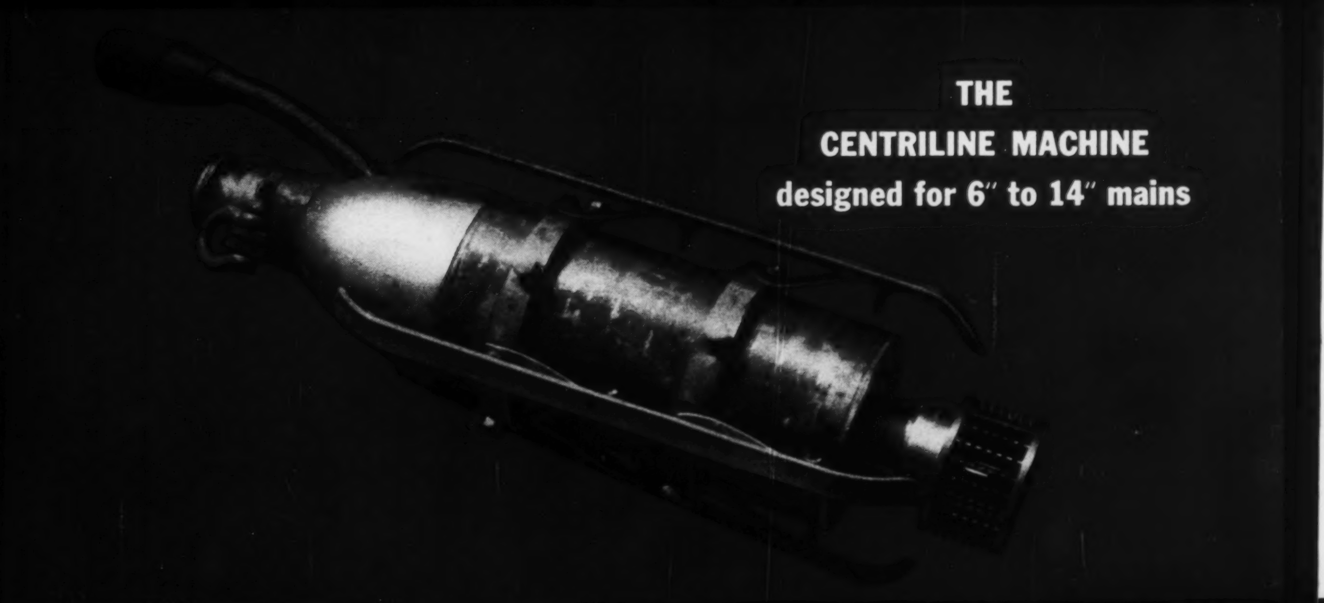
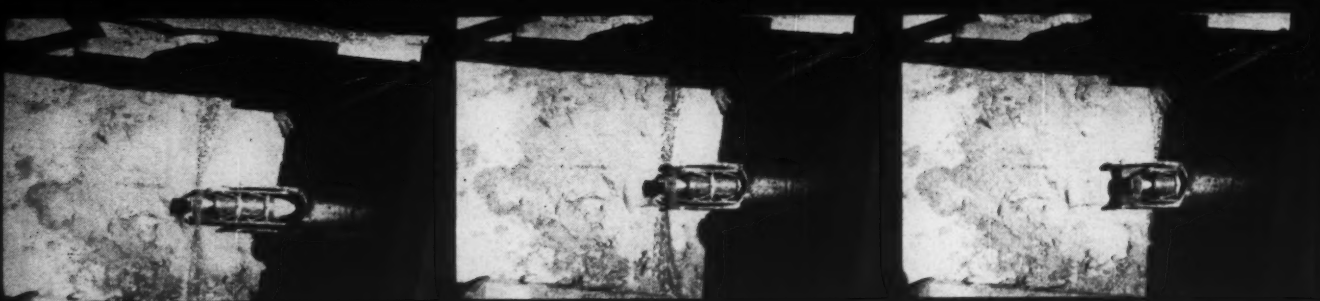




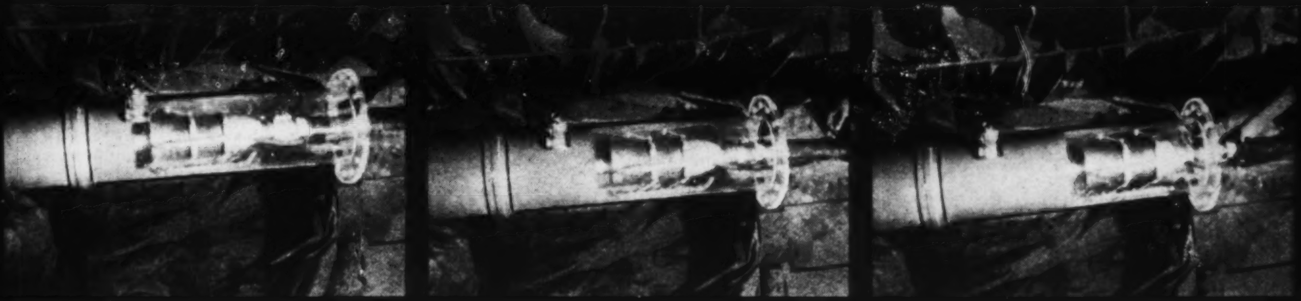
THE
CENTRILINE MACHINE
designed for 6″ to 14″ mains



STRIP PHOTO • TOP:	*Cross section view, in special transparent pipe, showing new small size Centriline machine in action being pulled through the pipe from left to right. Note the uniformity of the cement-mortar lining.*
STRIP PHOTO • BOTTOM:	*View of machine at work in special cut away pipe illustrating centrifugal application of the cement-mortar.*

in the water works field in the past 15 years!

is also available for 6″ to 14″ mains



NOW, for the first time, your city's small but important transmission and distribution lines, including those used for fire protection, can regain their original flow capacity and pressure through the famous Centriline Process. A smaller version of the Centriline machine has been developed for use in 6″ to 14″ mains.

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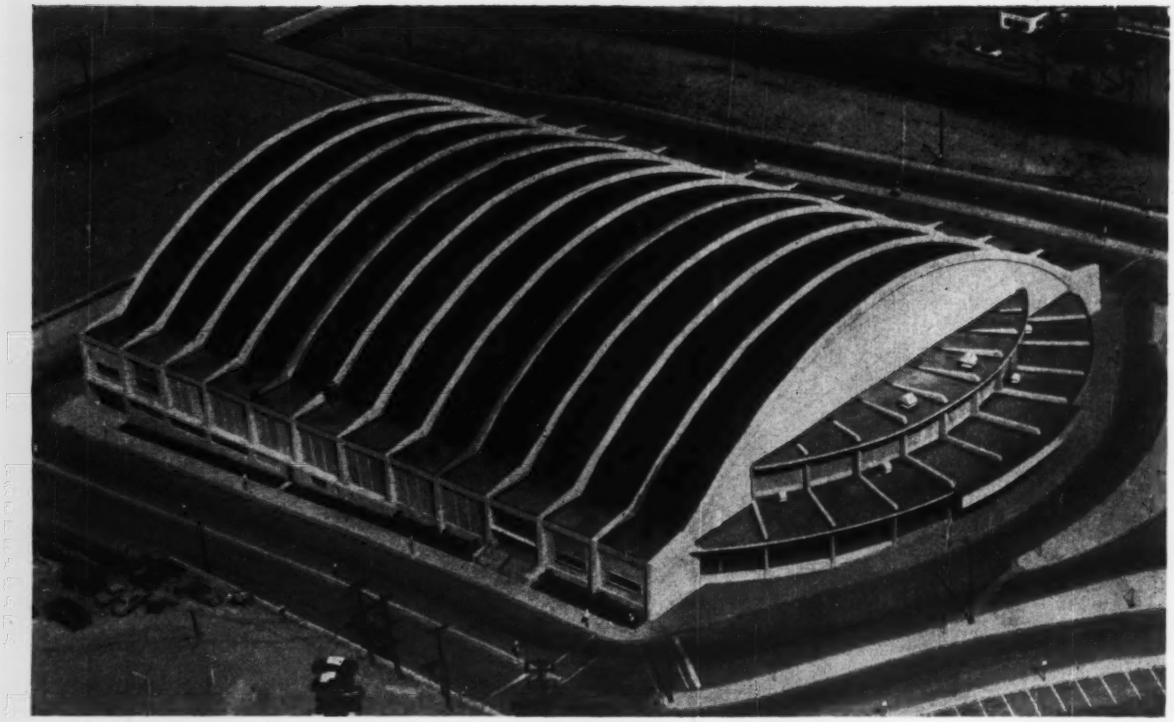

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Denver's Coliseum is a handsome example of the functional use of concrete for arenas requiring uninterrupted enclosed space with minimum maintenance. Its arched construction requires no supporting pillars and provides a clear and unobstructed view of the entire arena area. Only concrete, the completely plastic building material, can be so molded and formed into any shape with all of its strengthening reinforcement inside.

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You can obtain full information on SMS-Rotovalves, as well as the complete line of Ball Valves and R-S Butterfly Valves, by contacting our nearest representative. Or, write to S. Morgan Smith Company, York, Penna.

◀ *Overall view shows dry well and discharge risers. Close-up (lower photo) shows a 30-inch Rotovalve equipped with electric motor-driven operators.*

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AFFILIATE: S. MORGAN SMITH, CANADA, LIMITED, TORONTO

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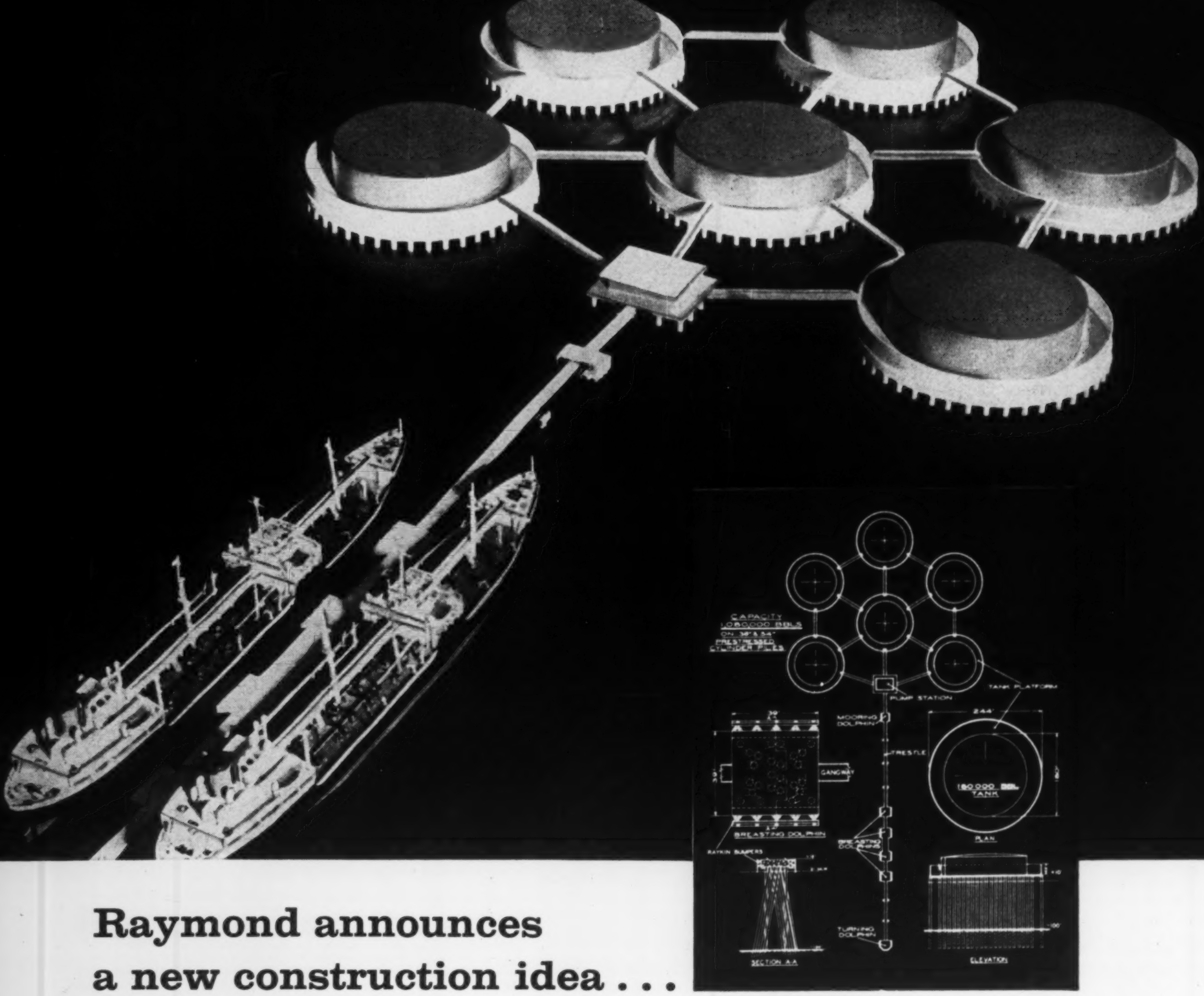
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These bulk storage islands with direct-loading facilities will be of particular interest to oil companies at Lake Maracaibo as well as other expanding, off-shore oil producing regions. The most obvious advantage of these units is that they eliminate the congestion on shore caused by increasing bulk storage and tanker loading operations.

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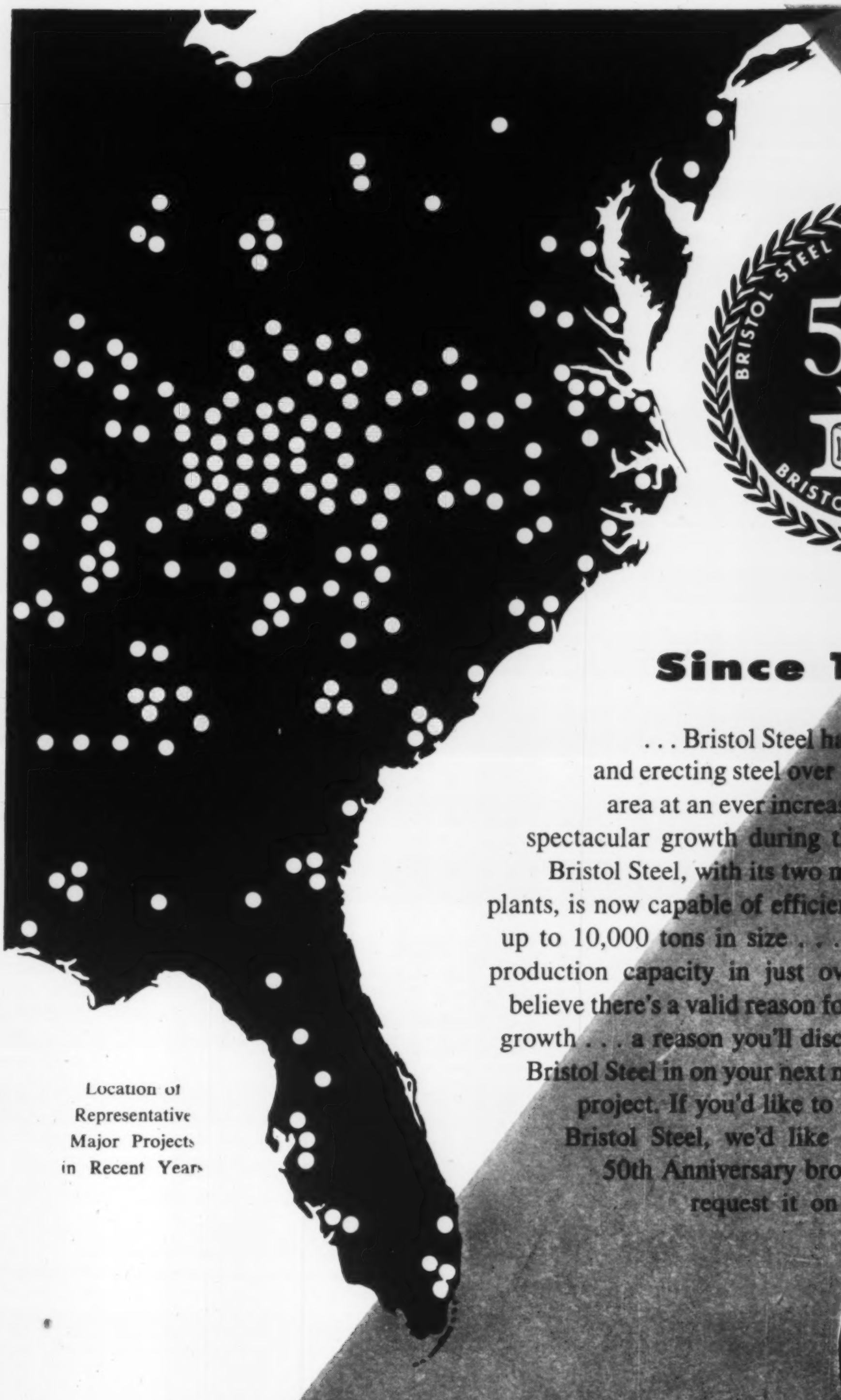

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structural steel
service since 1908
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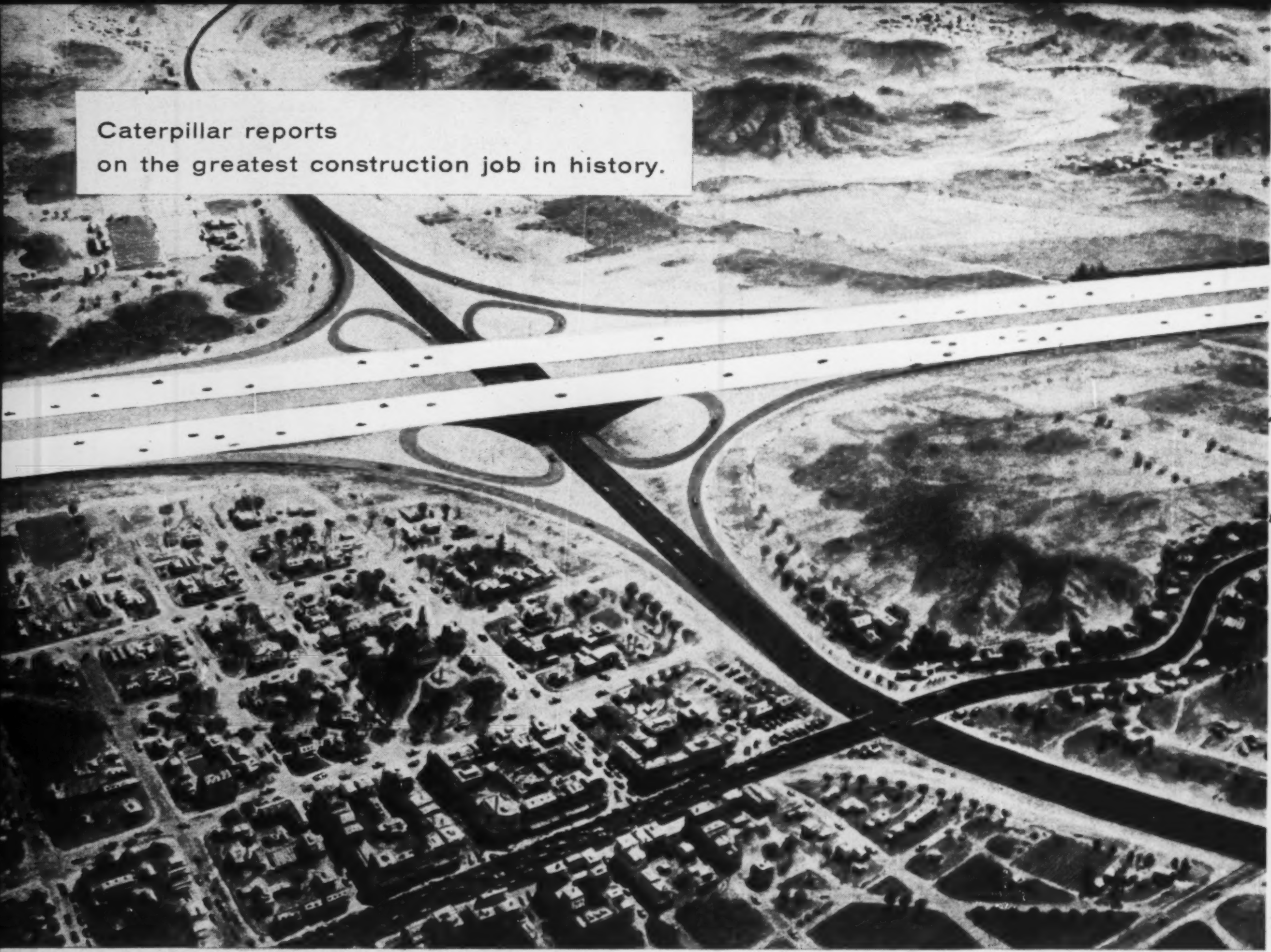


Caterpillar reports
on the greatest construction job in history.

Here's what a typical portion of the magnificent Interstate Highway System is going to look like.

[Colors refer to section of road in picture above.]

▨ ***INTERSTATE SYSTEM FREEWAY***

Depending on traffic demands, a Freeway will be 2, 4, 6 or 8 lanes—each lane at least 12 feet in width. Shoulders will be at least 10 feet; center strips, in rural areas, will be a minimum of 36 feet wide. States will set speed limits, but, to provide a margin of safety, the Freeways are designed for 50 MPH in urban areas to 70 MPH in open, flat country. These super roads will go around most towns to speed your trip and to give townspeople relief from dangerous congestion caused by through traffic. The Freeways will be of "Controlled Access" design. That means there will be no intersections. No railroad crossings. Not even driveways. This safety design is expected to save thousands of lives a year! When the Freeways cross a road like this—

■ ***STATE HIGHWAY***

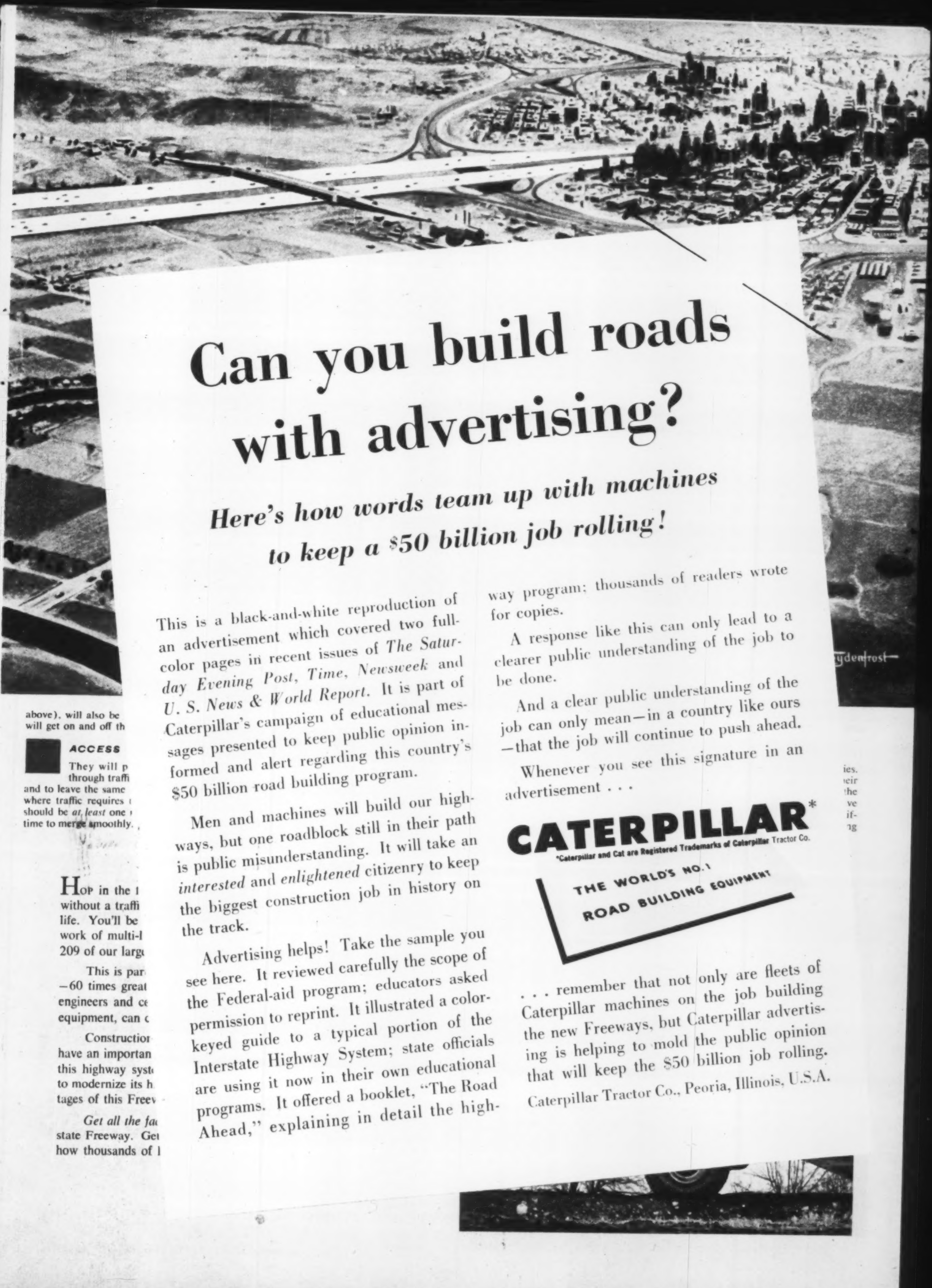
—either an underpass or overpass will be built, eliminating a dangerous intersection. State highways like this, and farm-to-market roads (dark gray

This is no dream! We're building 41,000 miles of Freeways like this

Work has started! Money's authorized!

It's the Interstate Highway System—part of the nation's gigantic

$50 billion road building program. Here's what it means to you.



Can you build roads with advertising?

Here's how words team up with machines to keep a $50 billion job rolling!

This is a black-and-white reproduction of an advertisement which covered two full-color pages in recent issues of *The Saturday Evening Post, Time, Newsweek* and *U. S. News & World Report.* It is part of Caterpillar's campaign of educational messages presented to keep public opinion informed and alert regarding this country's $50 billion road building program.

Men and machines will build our highways, but one roadblock still in their path is public misunderstanding. It will take an *interested* and *enlightened* citizenry to keep the biggest construction job in history on the track.

Advertising helps! Take the sample you see here. It reviewed carefully the scope of the Federal-aid program; educators asked permission to reprint. It illustrated a color-keyed guide to a typical portion of the Interstate Highway System; state officials are using it now in their own educational programs. It offered a booklet, "The Road Ahead," explaining in detail the highway program; thousands of readers wrote for copies.

A response like this can only lead to a clearer public understanding of the job to be done.

And a clear public understanding of the job can only mean—in a country like ours—that the job will continue to push ahead.

Whenever you see this signature in an advertisement . . .

CATERPILLAR*

*Caterpillar and Cat are Registered Trademarks of Caterpillar Tractor Co.

THE WORLD'S NO. 1
ROAD BUILDING EQUIPMENT

. . . remember that not only are fleets of Caterpillar machines on the job building the new Freeways, but Caterpillar advertising is helping to mold the public opinion that will keep the $50 billion job rolling.

Caterpillar Tractor Co., Peoria, Illinois, U.S.A.

above), will also be
will get on and off th

ACCESS

They will p
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and to leave the same
where traffic requires
should be *at least* one
time to merge smoothly.

Hop in the
without a traffi
life. You'll be
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equipment, can c

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Modern Versatility...

THREE-WAY USE OF ELLIPTICAL PIPE BY AMERICAN-MARIETTA

1. LO-HED PIPE carries a greater flow than its round equivalent—in a shallower trench with adequate depth of cover.

2. HI-HED PIPE is inherently stronger than its round pipe equivalent for use under extremely high fill. Makes full use of available cross-room without disturbing existing facilities.

Another example of PROGRESS IN CONCRETE

A-M's elliptical concrete pipe was chosen for this combination sewer project because of its increased self-cleansing velocities at periods of dry-weather flow—and used in three ways on this single job . . . as Lo-Hed, Hi-Hed and Inner Circles Pipe. The two mile line, engineered by Consoer Townsend & Associates, Chicago, runs from the Teletype Corporation in Niles, Illinois, to the north branch of the Chicago River.

American-Marietta's reinforced elliptical, as well as round, pipe is available in a full range of sizes with pretested strengths to meet various specifications—can be delivered in quantity when and where needed from any of A-M's many plants located from coast to coast.

Our technical staff will be pleased to assist you with your pipe problems

3. INNER CIRCLES PIPE allows passing of pipe through pipe underground without requiring excavations or disruption of surface traffic. Permits faster work at less cost in any weather.

A-M

AMERICAN-MARIETTA COMPANY

CONCRETE PRODUCTS DIVISION

GENERAL OFFICES:
AMERICAN-MARIETTA BUILDING
101 EAST ONTARIO STREET, CHICAGO 11, ILLINOIS, PHONE: WHITEHALL 4-5600

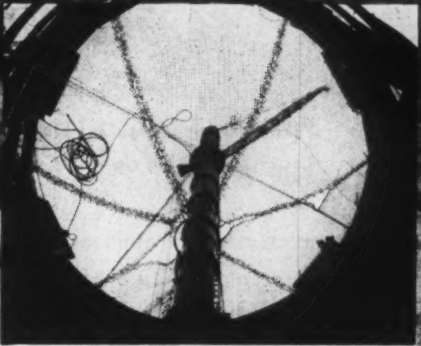
Taming over 7 Trillion Gallons of Turbulent Missouri River

CB&I Surge Tanks Serve Garrison Dam

When completed, the new Garrison Dam, opened in January 1956 near Riverdale, North Dakota, will provide 400,000 kilowatts of power, provide flood control and needed irrigation for large areas of both North and South Dakota. Its huge reservoir will form a lake 200 miles long to hold 7,494,573,000,000 gallons of, once turbulent, Missouri River water.

To control the now man-made turbulence of these waters as they race from reservoir to power tunnel, Army engineers of the Missouri River Division will rely on the six CB&I surge tanks shown above.

These 65 ft. diam. by 135 ft. high tanks are typical of pipelines, penstocks and steel plate structures CB&I has built for hydroelectric generating plants and for water diversion projects all over the world. Our plants are fully equipped and competently staffed to design, fabricate and *erect* such structures to *your* specifications. Write our nearest office for details.



Worm's-eye view looking up through safety net to boom tower used during erection of CB&I surge tanks at Garrison Dam.

CB&I

Chicago Bridge & Iron Company

Atlanta • Birmingham • Boston • Chicago • Cleveland • Detroit • Houston
New Orleans • New York • Philadelphia • Pittsburgh • Salt Lake City
San Francisco • Seattle • South Pasadena • Tulsa
Plants in BIRMINGHAM, CHICAGO, SALT LAKE CITY and GREENVILLE, PA.
REPRESENTATIVES AND LICENSEES:
Australia, Cuba, England, France, Germany, Italy, Japan, Netherlands, Scotland

Moretrench Wellpoints Make Short Work Of 14′ Of Water In Silt, Sand, and Sawdust...

Sedimentation Tanks, Grit Chambers, Pumping Station are all dewatered at once.
Heavy pile driving rig works without difficulty on mats.

Excavating for a sewerage treatment plant in Superior, Wis., presented quite a problem for Steenberg Construction Company of St. Paul, Minnesota:

Water was within one-half inch of the surface.

Material — top layer — silt, clay, and fill
middle layer — red sand, rubbish, 18″ of sawdust
bottom layer — clay

Yet,

ONE MORETRENCH PUMP WITH WELLPOINTS ON 7′ CENTERS GAVE THE CONTRACTOR A BONE DRY WORKING AREA!

Proving again, that if you're looking for economy, along with pumping satisfaction, you can't beat a Moretrench Wellpoint System.

Find out more about handling wet jobs profitably. Ask for our illustrated catalog.

MORETRENCH CORPORATION

90 West St.
New York 6

4900 S. Austin Ave.
Chicago 38, Illinois

7701 Interbay Blvd.
Tampa 9, Florida

315 W. 25th St.
Houston 8, Texas

Rockaway
New Jersey

Western Representative: Andrews Machinery of Washington, Inc., Seattle 4, Washington
Canadian Representative: Geo W CROTHERS Limited, Toronto, Ontario
Brazilian Representative: Oscar Taves & Co., Ltd., Rio de Janeiro

I'm glad we used the Roebling Bridge Division Specifications and Design Data Book!
"He says He's glad we used the Roebling Bridge Division Specifications and Design Data Book"
ROEBLING
BRIDGE DIVISION
JOHN A. ROEBLING'S SONS CORPORATION
SPECIFICATIONS AND DESIGN DATA
OH!
ROEBLING

Do you have this 22-page book? It contains the information required for the selection and preparation of specifications for wire, strand and rope used on guyed structures and suspended systems of all kinds (except major suspension bridges). For your copy, just write to Bridge Division, John A. Roebling's Sons Corporation, Trenton 2, New Jersey.

ROEBLING

Branch Offices in Principal Cities
Subsidiary of The Colorado Fuel and Iron Corporation

NEWS OF ENGINEERS

Howard F. Peckworth, Director of ASCE and managing director of the Concrete Pipe Association, Inc., of Chicago, has been appointed by Governor Stratton to a four-year term as a member of the Northern Illinois Local Governmental Area Planning Commission. The personal honor to Mr. Peckworth is also an honor to the profession, as it signifies the public's growing awareness of the importance of the engineer.

H. F. Peckworth

Hans F. Winterkorn, professor of civil engineering at Princeton University and a pioneer in the field of soil stabilization, has been awarded the Officer's Cross of the Federal Order of Merit in recognition of his achievements in science, engineering and education. The award is the highest civilian decoration the German government can confer. It is the successor to the Order "pour le merite," founded by King Frederick the Great in 1740.

James R. Graves has been appointed senior design engineer in the bridge section of Patchen and Zimmerman, Engineers of Augusta, Ga. Mr. Graves has served the Texas Highway Department for 17 years, as senior design engineer in the bridge section for the past nine years.

S. W. Spielvogel has been appointed staff consultant for Byrne Associates, Inc., and Stevens and Wood, Inc., New York utility and industrial consultants. Mr. Spielvogel was formerly connected with Consolidated Edison Co. of New York. He is the author of *Piping Stress Calculations Simplified.*

Allen F. Clark, Jr., Colonel, Corps of Engineers, and district engineer of the Philadelphia District, has been reassigned as division engineer of the North Pacific Division, Portland, Ore.

Clarke Donaldson retired recently as head of the Construction Department of the city of Atlanta. Mr. Donaldson has been associated with the city for a number of years.

Jim Boydston, former engineer for Multnomah County, Oregon, has joined the Portland firm of Stevens and Thompson.

C. D. Curtiss has retired as commissioner of the Bureau of Public Roads after 38 years of distinguished service with the Bureau. He has reached the mandatory retirement age.

Paul W. Thompson has been appointed general manager of the 27 International Editions of *Reader's Digest.* Mr. Thompson, one of the youngest American generals in World War II, joined the Digest in 1946 as director of the magazine's central European publishing, and established editions in France, Germany, Austria, Belgium and Switzerland. Early in his career, Mr. Thompson was granted a Freeman Fellowship for a year's study of hydraulic engineering in Europe.

P. W. Thompson

experience . . . the world over

DIFFICULT FIELD CONDITIONS do not stop Fairchild's experienced ground control crews. The Shoran jeep and trailer shown crossing a South American river is used to locate accurately the survey plane's position over water, jungle, or areas where no photomap exists. This is done by transmitting signals from the plane to two widely separated ground stations. The signals are instantly retransmitted back to the plane and the time required to make the round trip is automatically measured enabling the plane's location to be accurately determined.

Ground control plays an important role in assuring accurately-flown, on-time surveys. Call Fairchild for your next survey. Learn why engineers have been saying for over thirty years—*you can count on Fairchild.*

FAIRCHILD
AERIAL SURVEYS, INC.

LOS ANGELES, CALIF.: 224 East Eleventh Street · **NEW YORK CITY, N.Y.:** 30 Rockefeller Plaza · **CHICAGO, ILLINOIS:** 111 W. Washington St. · **LONG ISLAND CITY, N.Y.:** 21-21 Forty-First Ave. · **TALLAHASSEE, FLORIDA:** 1514 S. Monroe St. · **BOSTON, MASS.:** New England Survey Service, Inc., 255 Atlantic Ave. · **SHELTON, WASH.:** Box 274, Route 1

Samuel Lerner, professor at Brown University, who was on sabbatical leave during 1956-1957, has returned to Brown to resume teaching duties. The year was spent in Italy, at the University of Turin, where Professor Lerner studied structural engineering under Prof. Louis Colonnetti. Professor Lerner was awarded the Doctor of Engineering degree in July 1957.

Charles T. Tench, Colonel, U. S. Army (retired), has been appointed vice-president in charge of Louisiana and Texas operations for Palmer and Baker Engineers, Inc., of Mobile, Ala. His headquarters will be at 3004 Jefferson Highway, New Orleans.

Marvin J. Kudroff, associate in the firm of Daniel, Mann, Johnson, & Mendenhall, Architects & Engineers, of Los Angeles, Calif., has just been appointed director of engineering. Mr. Kudroff has been with DMJM for more than ten years as chief structural engineer, and has also served as project manager on many of the firm's major operations.

O. A. Dietz has been promoted to superintendent of the Northern District, Maintenance Division of the Engineering and Construction Bureau of the Panama Canal Company, Cristobal. Mr. Dietz has been connected with the Panama Canal since 1939, and has been assistant superintendent and planning engineer since 1948.

C. H. Topping, senior architectural and civil engineering consultant to the engineering department of E. I. du Pont de Nemours & Co., Wilmington, is new president of the Building Research Institute. He was erroneously listed as president of the Building Research Advisory Board in the October issue. **Edward X. Tuttle,** vice-president of Giffels and Vallet, Detroit, is chairman of the BRAB, a 30-man appointive group that offers advisory services on building technology to industry and government. The Building Research Institute was organized in 1952 to meet the need of the construction industry for an organization which could focus the attention of the entire industry on building research technology. Both groups are units of the National Academy of Sciences—National Research Council.

C. H. Topping

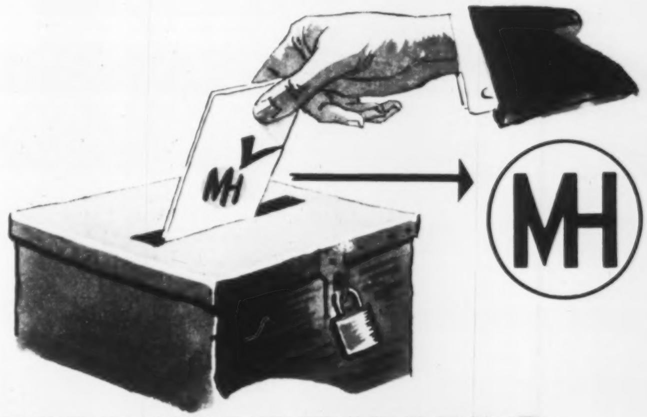
E. X. Tuttle

Hyde Forbes, engineer and geologist of Palo Alto, Calif., has announced his partial retirement from active practice. His office practice will be continued by **William G. Dunn** and **Richard S. Harding** in consultation with Mr. Forbes at 1535 Castilleja Avenue, Palo Alto.

Porter, Urquhart, McCreary & O'Brien have made two additions to the staff of their Newark, N. J., office. **J. C. Young,** chief of the department of highway design for the California Highway Department, has been appointed chief highway engineer. New chief engineer is **C. H. Darby,** who served the California Division of Highways for eleven years.

Jake Allen Carpenter, graduate student in the School of Civil Engineering at Cornell University, has been awarded the second Herbert T. Spencer fellowship for research on a phase of bituminous materials. Mr. Carpenter received his B.S. degree in civil engineering at the University of Nevada in 1955.

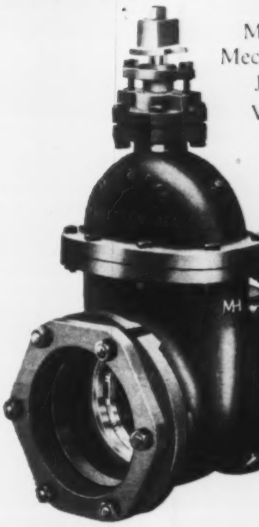
Byron O. McCoy, staff member of Charles T. Main, Inc., of Boston, has been elected vice-president of Vermont Electric Power Company, Inc. He will supervise construction, maintenance, and transmission of St. Lawrence power throughout the state. Mr. McCoy will make his home in Rutland, Vt.



ENGINEERING BALLOT BOX

We like to think of M & H valves and hydrants as "candidates" in an election contest. The "voters" are the engineers and water works men of the United States. The "ballots" are material specifications and purchase orders. As this "election" stands today, M & H products rank high among the winners.

For many years, the sale and use of M & H valves and hydrants has been rapidly and steadily growing. Our company has become a leading producer of valves, hydrants and accessories. Returns from the engineering ballot box we consider as an emphatic vote of confidence. Our pledge, therefore, is that M&H products shall continue to merit that confidence through the years to come.



M & H
Mechanical
Joint
Valve.

M&H VALVE
AND FITTINGS COMPANY
ANNISTON, ALABAMA

SUBSIDIARY OF WALWORTH

TIDE GATES

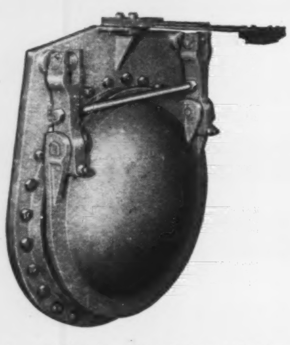


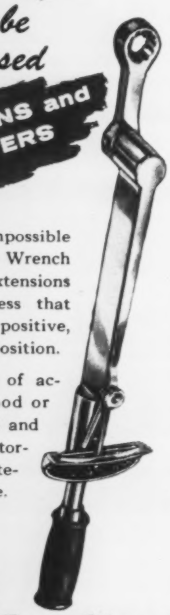
Figure B-175. Type M-R Gates designed especially for application to centrifugal pump discharge lines. A rubber seating ring is inserted in the seat to absorb the slap which occurs when pumps stop. A flexible bar connection is arranged between the hinge links to provide a stop for the gate shutter to prevent the outer edge of the shutter from tipping downwardly when flow abruptly ceases. Smaller sizes of gate are provided with a bumper arrangement to prevent the shutter being forced too widely open when flow starts.

Ask for Bulletin 73A

BROWN & BROWN, INC.
LIMA, OHIO, U. S. A.

Only ONE Torque Wrench can be accurately used with . . .

EXTENSIONS and ADAPTERS



It is mechanically impossible to use any Torque Wrench with adapters or extensions (with accuracy) unless that Torque Wrench has a positive, built-in, fixed load position.

This essential factor of accuracy, misunderstood or ignored in the design and manufacture of some torque tools, can completely defeat their purpose.

Patented pivoted handle fixes load position

Write for Torque Manual
with formulae tables and explanations for correct use of adapters and extensions.

P.A. STURTEVANT CO
ADDISON QUALITY ILLINOIS

Harry S. Lewis has been appointed engineering consultant to the U. S. Navy Administration Unit on the Island of Saipan. Under United Nations and Trust Territory agreements, the Navy administers all the affairs of Saipan, Tinian, and other islands in the Marianas. Mr. Lewis has just completed two years' work in Iceland on the airbase construction supervision program while connected with the Hedrick-Grove-Shepherd-Wilson-Kruge organization.

E. G. Bailey, retired vice-president of Babcock and Wilcox, and Honorary Member of ASCE, has been similarly honored by the American Society of Mechanical Engineers. Praised in the accompanying citation for his imaginative leadership and inspired guidance of youth, Mr. Bailey has written many papers on the curricula and policy of engineering schools and is a trustee of Lafayette College. He developed the Bailey Boiler Meter, which "revolutionized boiler operation."

Louis J. Rumaggi of Chicago, Ill., has been promoted to the rank of major general in the Army Corps of Engineers. The twin-star general became Division Engineer in July of this year, and is supervising the most extensive program ever undertaken by the Corps of Engineers in the Great Lakes Area.

Carey H. Brown, ASCE Director of District 3, and retired Eastman Kodak official, has been made a Fellow in the American Society of Mechanical Engineers. To receive this honor, an engineer must have made outstanding and recognized contributions to the advancement of the science of engineering. Mr. Brown lives in Scottsville, N. Y.

E. C. Wenger, since 1947 manager of the Conservation Bureau of the Portland Cement Association, retired on December 1. Mr. Wenger has been on the association's staff since 1934, and for 13 years was regional highway engineer for its midwest region. He plans to practice as a consulting engineer in the highway and municipal improvement field.

Leonard C. Halpenny, a consultant specializing in ground-water hydrology and related fields, announces the opening of the Water Development Corporation. The new firm will be located at 3938 Santa Barbara Avenue, Tucson, Ariz.

Edmund Astley Prentis, one of the founders of the New York firm of Spencer, White & Prentis, has been selected as the recipient of the 1958 Alexander Hamilton Medal. The medal, the highest honor awarded annually by the Columbia College Alumni Association, is presented to an alumnus or faculty member for "distinguished service in any field of human endeavor."

Three members of ASCE received the American Institute of Planners' "Distinguished Service Award" this year. **Lawrence V. Sheridan, Harold M. Lewis,** and **Ladislas Walter Segoe,** all members of the ASCE City Planning Division Executive Committee, were awarded the Institute's highest tribute for their outstanding work in city design and planning. Mr. Sheridan, president of Metropolitan Planners, Inc., of Indianapolis, Ind., is a past-president of the Institute, and past chairman of the ASCE City Planning Division. Mr. Lewis, New York City consulting engineer and city planner, was commended for his "leadership in the modern science of planning . . . (and as a) definitive author and scholar." Mr. Lewis is a past-president of the Institute. Mr. Segoe, a consulting engineer and city planner, is a member of the Cincinnati (Ohio) firm bearing his name. He was praised for his outstanding contributions to the field of city planning.

L. W. Segoe

H. M. Lewis

L. V. Sheridan

Bob Lium, until recently with the firm of Moffatt, Nichol and Taylor, Portland, Ore., has moved to Anchorage, Alaska, to accept a position with the Civil Aeronautics Administration. He has been co-editor of *Oregon Civil Engineer.*

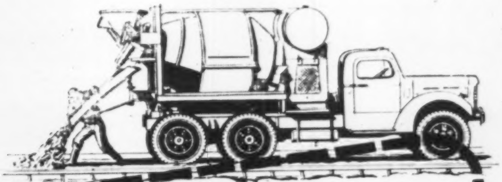
Charles P. Dunham has been appointed assistant project manager of Nuclear Projects, Architect-Engineer Division of Aerojet General Corporation, a subsidiary of General Tire & Rubber Company. Mr. Dunham, a 1951 graduate of the University of Missouri, has been practicing in Los Angeles County for the past six years.

Paul S. Symonds, of the Engineering faculty at Brown University, will spend his sabbatical leave in 1957-1958 at the University College of Swansea in Wales. He has received both Fulbright and Guggenheim awards.

Kenneth E. Carter has joined Gibbs & Hill, Inc., at Tampa, Fla., as assistant highway engineer, in charge of roadway design. Previously he was project engineer with Lockwood, Kessler & Bartlett, Inc., and an engineer for the California Division of Highways.

(Continued on page 113)

No time lost when concrete is



SPECIAL WINTERIZED

with SOLVAY CALCIUM CHLORIDE

You save four ways when you order ready-mix that is "special winterized," including SOLVAY Calcium Chloride:

1. You save overtime finishing, because it sets faster.
2. You save delays in form removal, because it develops high early strength.
3. You save delays between operations.
4. You can save up to 50% on protection time.

For the low cost of adding 2% of SOLVAY Calcium Chloride to concrete, you can actually maintain warm weather working schedules in winter. And you get *better* concrete! Ultimate strength at one to three years is actually 8 to 12% greater. Your product is more workable. With lower water-cement ratio, you get denser, more moisture-and-wear-resistant concrete.

SOLVAY ®

Solvay Calcium Chloride speeds but does not change the normal chemical action of portland cement. Impartial tests by the National Bureau of Standards prove its advantages in cold weather construction and concrete work. It is recommended or approved by leading authorities, including American Concrete Institute and Portland Cement Association.

Write now for full data!

SOLVAY PROCESS DIVISION

Allied Chemical

ALLIED CHEMICAL & DYE CORPORATION
61 Broadway, New York 6, N. Y.

BRANCH SALES OFFICES:
Boston • Charlotte • Chicago • Cincinnati • Cleveland • Detroit • Houston
New Orleans • New York • Philadelphia • Pittsburgh • St. Louis • Syracuse

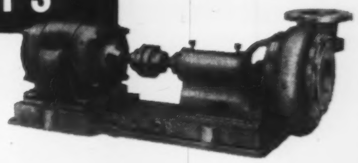
---

IMAGINE THAT! *The BALANCED Impeller may be trimmed to suit other heads and capacities -- yet REQUIRES NO SEPARATE COUNTERBALANCE.*

PATENT PENDING

AURORA
NON-CLOG
HORIZONTAL & VERTICAL
MONO-VANE
SINGLE PASSAGE IMPELLER
PUMPS

WRITE
for
BULLETIN 121 MV



Type KGG Aurora Horizontal Mono-Vane Non-Clog Pump

The exclusive new Mono-Vane impeller represents a major advance in the technique of non-clog pumping. This unique impeller can be trimmed to various diameters — REQUIRES NO SEPARATE COUNTERBALANCE because it is in dynamic and hydraulic balance — and affords a wide range of operation by merely trimming the impeller for each head and capacity requirement.

UNSURPASSED FOR HANDLING LONG STRINGY SOLIDS

•

IDEAL FOR ELEVATING SEWAGE — PUMPING SLUDGE — HANDLING HEAVY SETTLEABLE SOLIDS, EFFLUENT AND OTHER WASTES

•

TROUBLE-FREE PERFORMANCE — CONVENIENCE and LASTING ECONOMY

•

DISCHARGE MAY BE TURNED TO ANY POSITION — ACCESSIBLE for CLEANING

•

SMOOTH, QUIET OPERATION

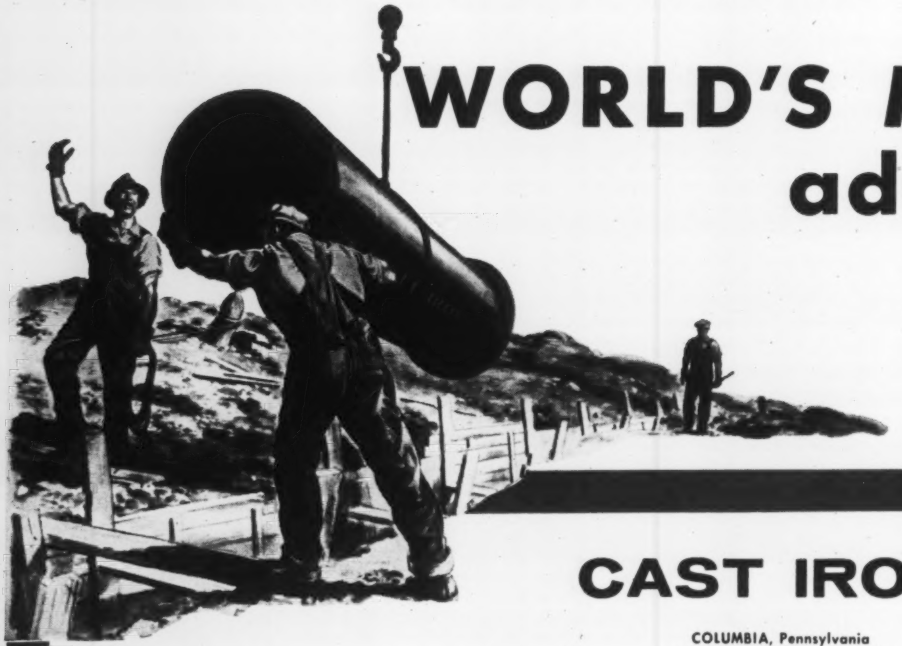
Type KU Aurora Vertical Mono-Vane Non-Clog Pump

Your Inquiries Will Command Our Prompt Attention

AURORA *Always* PUMPS

DISTRIBUTORS IN PRINCIPAL CITIES

AURORA PUMP DIVISION
THE NEW YORK AIR BRAKE COMPANY
57 LOUCKS STREET • AURORA • ILLINOIS
EXPORT DEPARTMENT — Aurora, Illinois — Cable Address "NYABINT"



WORLD'S MOST adds 20

CAST IRON PIPE

*ADRIAN, Michigan
Citizens Gas Fuel Company
ALBANY, New York
Dept. of Water and Water Supply
ALBANY, New York
Niagara Mohawk Power Corp. (Gas)
ALEXANDRIA, Virginia
Alexandria Water Company
ALLENTOWN, Pennsylvania
Bureau of Water
*ALTON, Illinois
Union Electric Company, Gas Division
ATLANTA, Georgia
Atlanta Gas Light Company
BALTIMORE, Maryland
Bureau of Water, Dept. of Public Works
BALTIMORE, Maryland
Baltimore Gas and Electric Company
*BANGOR, Maine
Citizens Utilities Company, Gas District
*BETHLEHEM, Pennsylvania
The United Gas Improvement Company
BOSTON, Massachusetts
Public Works Dept., Water Division
BOSTON, Massachusetts
Boston Consolidated Gas Co.
BOUND BROOK, New Jersey
Public Service Electric & Gas Co.
BRIDGEPORT, Connecticut
Bridgeport Gas Light Company
BUFFALO, New York
Dept. of Public Works, Div. of Water
*CAMBRIDGE, Massachusetts
Cambridge Water Board
*CARLISLE, Pennsylvania
The United Gas Improvement Co., Gas Division
*CATASAUQUA, Pennsylvania
The United Gas Improvement Company
*CHAMBERSBURG, Pennsylvania
Borough of Chambersburg, Gas Department
CHARLESTON, South Carolina
South Carolina Electric & Gas Co.
CHICAGO, Illinois
Peoples Gas Light & Coke Company
CHICAGO, Illinois
Water Works Department
CINCINNATI, Ohio
Cincinnati Gas & Electric Co.
COLUMBIA, Pennsylvania
Columbia Water Company
DETROIT, Michigan
Board of Water Commissioners
DETROIT, Michigan
Michigan Consolidated Gas Co.
ELIZABETH, New Jersey
Elizabethtown Consolidated Gas Co.
EVANSVILLE, Indiana
Southern Indiana Gas & Electric Co.
FALL RIVER, Massachusetts
Fall River Gas Works Company
FREDERICK, Maryland
City of Frederick Water Dept.
FREDERICK, Maryland
Frederick Gas Company, Inc.
CITY OF FREDERICKSBURG, Virginia
Gas Department
*HAGERSTOWN, Maryland
Hagerstown Gas Company
HALIFAX, Nova Scotia
Public Serv. Co., Public Water Supply
*HARRISBURG, Pennsylvania
The United Gas Improvement Co., Harrisburg Gas Div.
HARTFORD, Connecticut
The Hartford Gas Company
HARTFORD, Connecticut
Water Bureau, Metropolitan District
HUNTSVILLE, Alabama
Municipal Water Works
INDIANAPOLIS, Indiana
Citizens Gas & Coke Utility
KNOXVILLE, Tennessee
Knoxville Utilities Board (Gas)
*LAMBERTVILLE, New Jersey
City Gas Company
LANCASTER, Pennsylvania
Bureau of Water
LOUISVILLE, Kentucky
Louisville Gas & Electric Co.
LYNCHBURG, Virginia
City of Lynchburg Water Dept.
MADISON, Indiana
Natural Gas Service, Inc.
MEDIA, Pennsylvania
Philadelphia Electric Company Gas Dept.
MINERSVILLE, Pennsylvania
Municipal Authority, Borough of Minersville
MOBILE, Alabama
Mobile Gas Service Corp.

CAST IRON PIPE

UNUSUAL CLUB
new members

The Cast Iron Pipe Century Club . . . Membership in this distinguished Club is restricted to water and gas supply systems still serving their communities through cast iron mains laid a hundred years ago . . . and more!

The Club's unique Honorary Certificate is earned only through performance. It is a tribute to the service supplied by these companies and to the carrier that enabled them to earn it . . . world's most dependable pipe . . . cast iron!

CENTURY CLUB

- **MOBILE, Alabama**
  - Mobile Water Works Company
- **MONTREAL, Quebec**
  - Quebec Hydro-Electric Commission
- **MONTREAL, Quebec**
  - Public Works Dept., Water-Works & Sewerage Division
- ***MOUNT HOLLY, New Jersey**
  - The Mount Holly Water Company
- ***NANTUCKET, Massachusetts**
  - Nantucket Gas & Electric Company
- **NASHUA, New Hampshire**
  - Pennichuck Water Works
- **NASHVILLE, Tennessee**
  - Waterworks Department
- **NEW BRUNSWICK, New Jersey**
  - Public Service Electric & Gas Co.
- ***NEWBURGH, New York**
  - Water Department
- **NEW HAVEN, Connecticut**
  - New Haven Gas Company
- **NEW ORLEANS, Louisiana**
  - New Orleans Public Service Inc. (Gas)
- **NEWARK, New Jersey**
  - Public Service Electric & Gas Co.
- ***NEW YORK, New York**
  - Consolidated Edison Company of N. Y., Inc., Gas Div.
- **NEW YORK, New York**
  - Dept. of Water, Gas & Electricity
- **NORRISTOWN, Pennsylvania**
  - Philadelphia Electric Co., Gas Dept.
- ***NORWICH, Connecticut**
  - Department of Public Works, Gas Division
- ***OTTAWA, Ontario**
  - Ottawa Gas
- **PAINESVILLE, Ohio**
  - City of Painesville, Gas Distribution Dept.
- **PEORIA, Illinois**
  - Central Illinois Light Company
- **PHILADELPHIA, Pennsylvania**
  - Dept. of Public Works, Bureau of Water
- **PHILADELPHIA, Pennsylvania**
  - Philadelphia Gas Works Co.
- **PITTSBURGH, Pennsylvania**
  - Bureau of Water, Dept. of Public Works
- **PLYMOUTH, Massachusetts**
  - Plymouth Gas Light Company
- **POTTSVILLE, Pennsylvania**
  - Pottsville Water Company
- ***POUGHKEEPSIE, New York**
  - Central Hudson Gas & Electric Corporation, Gas Division
- **PROVIDENCE, Rhode Island**
  - Providence Gas Company
- **QUEBEC, Quebec**
  - Quebec Power Co., Gas Division
- **READING, Pennsylvania**
  - Bureau of Water
- **RICHMOND, Virginia**
  - Department of Public Utilities (Gas)
- **RICHMOND, Virginia**
  - Dept. of Public Utilities (Water)
- **ROCHESTER, New York**
  - Rochester Gas & Electric Corp.
- **SACRAMENTO, California**
  - Division of Water & Sewers
- **ST. JOHN, New Brunswick**
  - Water & Sewerage Department
- **ST. LOUIS, Missouri**
  - Dept. of Public Utilities, Water Div.
- **SALEM, Massachusetts**
  - North Shore Gas Company
- ***SANDUSKY, Ohio**
  - The Ohio Fuel Gas Company
- **SAVANNAH, Georgia**
  - South Atlantic Gas Company
- **SPRINGFIELD, Illinois**
  - Central Illinois Light Company
- **SYRACUSE, New York**
  - Water Div., Dept. of Engineering
- **TORONTO, Ontario**
  - The Consumer's Gas Co. of Toronto
- **TROY, New York**
  - Department of Public Works
- **UTICA, New York**
  - City of Utica, Board of Water Supply
- ***WASHINGTON, D. C.**
  - Washington Gas Light Company
- **WHEELING, West Virginia**
  - City of Wheeling Water Department
- **WILLIAMSPORT, Pennsylvania**
  - Williamsport Municipal Water Authority
- **WILMINGTON, Delaware**
  - Wilmington Water Department
- **WINCHESTER, Virginia**
  - Water Department
- **WINSTON-SALEM, North Carolina**
  - Water Department
- **YORK, Pennsylvania**
  - York Water Company
- **ZANESVILLE, Ohio**
  - Water Department

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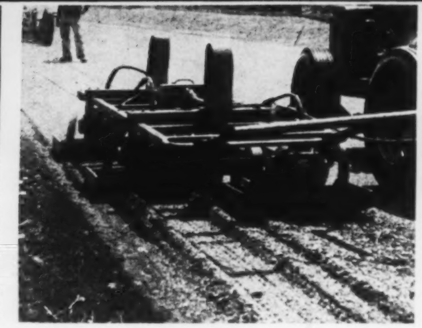

PAVEMENT WIDENING. Any arrangement desired of the vibratory units of the Jackson to fit the job most advantageously and provide 100% of required density in ONE PASS is easily and quickly made.

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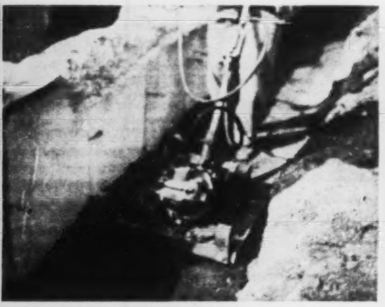

SOIL COMPACTION. Self-propelling, the Jackson Compactor, with 12'' to 26'' interchangeable bases, achieves specified density of granular soils in 6'' to 8'' layers at the rate of 600 sq. yds. per hr. Perfect for bridge and pipe line fills, concrete floor sub-bases and similar applications.

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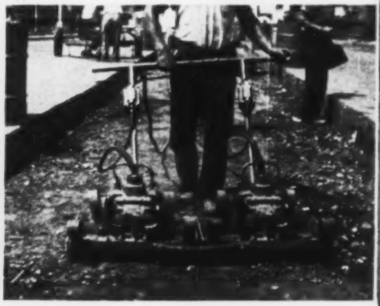
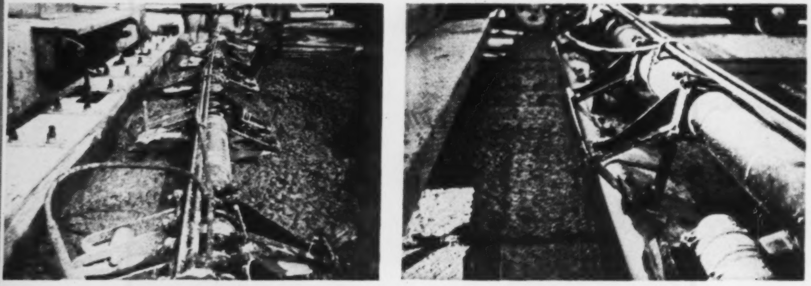


TWIN-UNITS — ONE OPERATOR. With a two-unit, side-by-side or tandem hookup of JACKSON COMPACTORS, one man can readily do the work of two, since the compactors are self-propelling and he has only to guide them.



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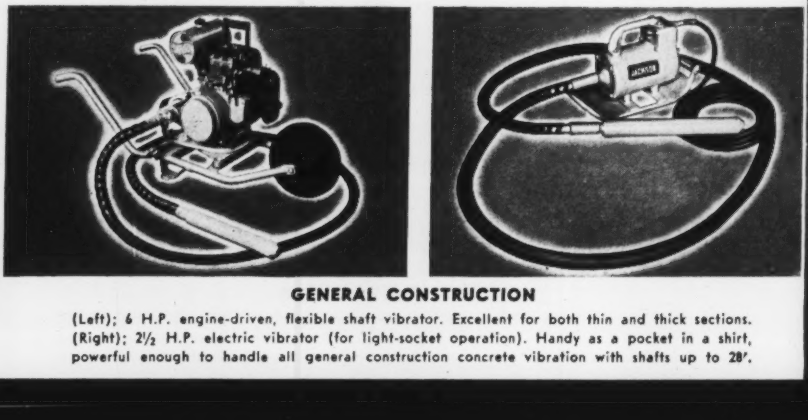

GENERAL CONSTRUCTION

(Left); 6 H.P. engine-driven, flexible shaft vibrator. Excellent for both thin and thick sections. (Right); 2½ H.P. electric vibrator (for light-socket operation). Handy as a pocket in a shirt, powerful enough to handle all general construction concrete vibration with shafts up to 28'.

. . . . . Am-Soc Briefs

▶ ▶ With a kick-off total of over a million dollars, the voluntary fund-raising campaign for the United Engineering Center got off to a flying start at a dinner on November 21. The importance of the new center to the welfare of the country was stressed in talks by former President Hoover, Deputy Secretary of Defense Quarles, and a host of other speakers representing management and industry at top level . . . More about the kick-off dinner and campaign in the Society News lead.

▶ ▶ Engineering salaries in the first three grades held reasonably firm in the Society's fourth quarterly Engineering Salary Index. Isolated instances of significant increases showed up, but these were most frequently in areas where they have been relatively low and indicated successful efforts to bring salaries in line with the national picture. Salaries in the consulting field are showing more volatility than in the preceding quarter.

▶ ▶ The Task Committee on Classification of Members has been analyzing member comment on its Interim Report (printed in the July issue) for the information of the Board, which will consider the classification proposal at its meeting during the Chicago Convention. Forty Local Sections, speaking for their members, forwarded comments.

▶ ▶ Speaking of the Chicago Convention . . . Something new in ASCE Convention history will be the Electronic Computer Demonstration, an all-day show, Monday through Thursday, put on by five firms that make computing equipment. Use of the small computers, which promise to become as indispensable to the civil engineer as the slide rule, will be covered in several of the numerous sessions arranged by twelve of the Technical Divisions (vide the full program, this issue).

▶ ▶ A reminder . . . The biennial ASCE Membership Directory will be published this spring. . . . For the convenience of members who may have overlooked our request for Directory data in the December issue, we are repeating (page 114) the coupon that appeared in that issue. Please fill out the coupon and return it only if you have job or address changes to report.

▶ ▶ More about publications . . . The best Proceedings papers of the past several years have been edited and assembled in the 1957 (Vol. 122) ASCE Transactions. There is a coupon in the advertising section to simplify ordering this latest compilation of technical papers. . . . The Report on Economic Advancement Objectives, submitted to the Board during the recent Annual Convention, is now available as Proceedings Paper 1490. Members may obtain copies as part of their quota of free papers.

▶ ▶ On the honors list . . . The Kansas City Section for its masterly hosting of a highway conference this November, attended by 600 engineers and officials from fifteen states. . . . The Tennessee Valley Section for its "big-time, Convention-style" annual meeting, attended by 350 — some 40 percent of its assigned membership compared with the 3 percent of ASCE membership on hand for national Conventions.

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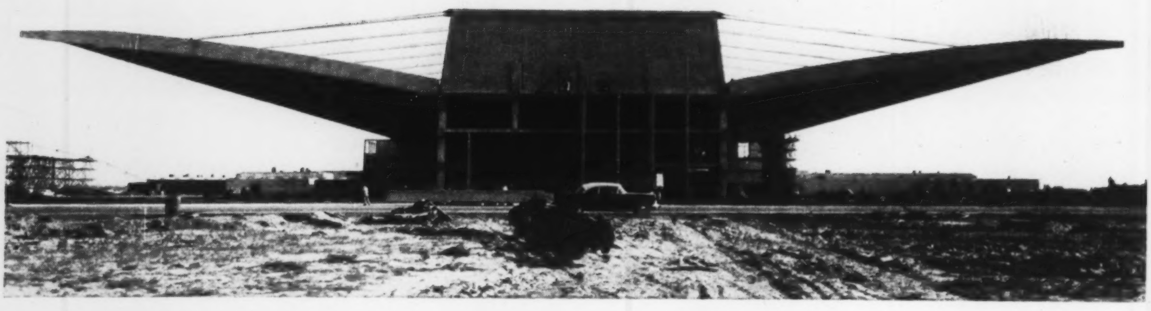
Concrete Wings Over Idlewild!

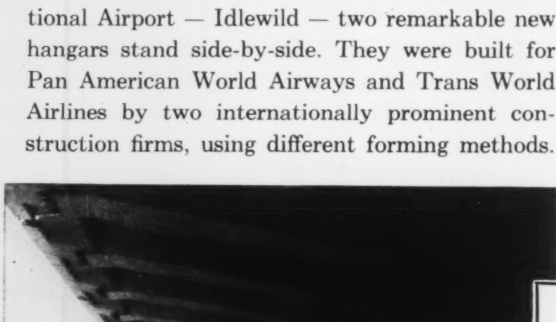


'INCOR' CONCRETE CANTILEVER ROOFS PROVIDE VAST FIRE-SAFE HANGAR SPACE FOR PAN AM AND TWA

• At New York's bustling, burgeoning International Airport — Idlewild — two remarkable new hangars stand side-by-side. They were built for Pan American World Airways and Trans World Airlines by two internationally prominent construction firms, using different forming methods.

Both hangars feature lightweight concrete cantilevered roofs 4½-in. thick, suspended by cables from anchor walls that span the central core structure. Wing-tip to wing-tip the hangar shown is 360-ft. wide; its mate is 412-ft. wide. Beneath these "wings" extends vast unobstructed hangar space where several giant airliners can be serviced simultaneously on both sides of the hangars. Over 30,000 bbls. of 'Incor'*—America's first high early strength portland cement—and 45,000 bbls. of Lone Star Cement were used in the structures.

*Reg. U.S. Pat. Off.



UNDER A WING. Each cantilevered section spans a vast area. Doors will ride on rails, far left. Piping is for radiant heating. Sunlit gaps across shadow indicate roof slab joints still ungrouted.

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PORT OF NEW YORK AUTHORITY

•

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New York, N.Y.

Contractor:
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New York, N.Y.

Ready-Mix Concrete:
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PAN AMERICAN WORLD AIRWAYS
Atlantic Division

Architect-Engineer:
CHESTER L. CHURCHILL

Structural-Engineers:
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Contractor:
CORBETTA CONSTRUCTION CO.

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do you know that

Mexico City is looking to its traffic problems? To all who have ever tried to drive in the popular capital south of the border it will be good news that Mexico City has just completed a five-mile four-lane crosstown expressway—most of it in open cut. The new Viaducto Miguel Aleman, connecting with the Puebla highway from the east and the Toluca highway from the west, is part of a $10,000,000 road program initiated by the city to help solve its mushrooming traffic problem. The overall plan for speeding traffic through and around the city calls for similar expressways on the northern and southern perimeters of the city, which will connect with all the major highways. Since 1950 Mexico City's population has soared from three to four million, and the number of vehicles owned has risen from 74,000 to 270,000.

• • •

There is plenty of scholarship money available to deserving students? The U.S. Office of Education reports that scholarship money available to undergraduate college students has increased two and a half times in the past five years. In 1,562 institutions enrolling more than nine-tenths of the nation's students, there were 237,000 scholarships valued at $65,700,000 in the 1955-1956 school year, compared with 124,000 scholarships worth $27,000,000 in 1950-1951. In the same period graduate fellowships almost doubled. Information on financial aid to college students is rounded up in two recent Office of Education Bulletins available from the Government Printing Office (Washington 25, D. C.). The undergraduate bulletin is $1.00, and the graduate bulletin 50 cents.

• • •

The country's first full-scale nuclear power plant began operation at Shippingport, Pa., on December 2? After a short test period this $110,000,000 utility of the AEC and the Dusquesne Light Company will begin supplying commercial electrical energy (60,000 ekw) to the Pittsburgh area. Its pressurized water reactor is fueled with 165 pounds of highly enriched U 235 surrounded with a blanket of 12 tons of natural U 238. England's Calder Hall, placed in operation in 1956, is believed to be the world's first full-scale atomic-powered electrical station.

• • •

The government's incentive awards program paid off handsomely last year? For their efforts beyond job requirements, federal employees are thanked with cash and honorary awards. The Civil Service Commission reports that in the past year "their constructive ideas and superior work performance have brought about measurable improvements in government operation worth more than $169,000,000." Of 322,000 suggestions advanced, more than 86,000 were good enough to be put to work. In addition, more than 41,000 employees were recognized for producing superior results on the job.

• • •

No St. Lawrence Seaway tolls will be imposed in 1958? On the theory that it would be neither fair nor feasible to charge for use of an incomplete project, U.S. and Canadian officials have decided that in 1958 they will merely recruit and train the personnel needed to collect tolls after the Seaway is finished and in full operation.

• • •

The serious shortage of schools will continue? Despite prospects for the biggest construction year since the war, only a 4,000 dent in the nation's accumulated shortage of 159,000 classrooms can be expected in 1958. Of the 69,000 classrooms scheduled for construction, 45,000 will be needed to meet enrollment increases and 20,000 more to replace obsolete units. The entire November issue of *Architectural Forum* is devoted to problems and progress in U. S. school design and construction.

• • •

The nation's traffic bill for 1957 comes to a staggering $7,255,600,000? This is the estimated cost of a single year's traffic mayhem based on figures for the first nine months of the year and a projection through December 31. It is the highest figure in the history of the automobile. Included are charges for property damage, automobile repair, legal and medical fees, insurance expenses, and loss of income through absence from work. The estimated total is 11,700,000 accidents, resulting in 1,856,000 injuries, and 38,300 deaths—a sharp increase over the 1956 toll in accidents and injuries but a slight decline from the all-time death rate set in that year. Source of these figures is the Association of Casualty and Surety Companies.

• • •

An AMA unit has endorsed fluoridation? On the basis of a year-long study, the House of Delegates of the American Medical Association voted at a recent meeting that fluoridation of public water supplies is "not harmful to the general health." On the affirmative side, also, is a report of the World Health Organization that in seventeen nations where fluoridation is practiced tooth decay has been reduced about 60 percent.

CIVIL
ENGINEERING

A proper home for the engineers of America

HERBERT HOOVER, Hon. M. ASCE

President Hoover's stimulating keynote address, which follows, was presented at a dinner in New York's Waldorf-Astoria Hotel on November 21, 1957, announcing the start of the campaign to raise five million dollars from the nation's industrial leaders as their contribution toward the ten-million-dollar United Engineering Center.

Mr. Hoover is honorary chairman of the fund-raising campaign. Alfred P. Sloan, Jr., is honorary vice chairman, and Dr. Mervin J. Kelly is general chairman. Other speakers were James R. Killian, Jr., Donald A. Quarles, Ralph J. Cordiner, and Walter J. Barrett, President of United Engineering Trustees.

This meeting has been called for the promotion of new and adequate national headquarters for the engineering profession and for discussion of some of our national engineering problems.

Today marks the launching of a drive by the United Engineering Societies for the funds to erect a new building. We need the support of all our members. And especially do we need support from industry.

The activities of these societies are of vital importance to the American people, to the engineers, and to the industries.

We have about 250,000 engineer members in these societies, and the membership is constantly increasing. We are overcrowded in our present headquarters. It has become clear that we must have more room if we are to effectively conduct what has become one of the nation's greatest educational centers.

Our library—the greatest engineering library in the country—is overflowing. Our present building is inadequate to provide for the great meetings of our members. At these meetings new steps of progress in engineering are presented to the world, and the road to further advance over new frontiers is illuminated.

Our present building has insufficient quarters for housing, for food facilities and for social gatherings of the profession. From these personal associations spring many new and useful ideas for service to the American people. We have a site. We urgently need to start our new building. It is of national importance.

You no doubt have listened to the recent explosions over the failure of our educational system to provide this country with adequate scientific and engineering staff. I need not tell you that for ten years the engineers of America have been relating their agonies over this to everyone who would listen.

It seems that it required Sputnik to awaken the country to certain facts of life. The answer, however, is not more Sputniks but something right down to earth.

This subject has been investigated, reported upon, and its critical necessity thundered by the scientific and engineering professions during all these past ten years. I am not going to repeat the statements of our committees or even my own shrieks of alarm during these years.

Critical need for engineers

The trouble is that we are turning out annually from our institutions of higher education perhaps fewer than half as many scientists and engineers as we did seven years ago. The greatest enemy of all mankind—the Communists—are turning out twice or possibly three times as many as we are.

Tonight I am going to state bluntly my own views as to one of the major causes of our predicament. One of the roots of our problem is in our high schools. Today they are turning out more than 1,500,000 graduates annually. No one can tell me that these youngsters are of less mental ability and ambitious character than the youngsters of ten years ago.

Unless we have now degenerated in these racial qualities beyond the point of saving our American way of life and our national defense, there must be 60,000 or 70,000 more young men and women of this quality and ability who could be channeled into these professions every year.

Our higher institutions of learning have the capacity to train the recruits we need. The harsh fact is that the high schools are not preparing youngsters for the entrance requirements which must be maintained by our institutions training scientists and engineers.

The origin of this deficiency is well indicated by a careful sampling taken not too long ago, which showed that under 12 percent of the high school students were being taught the elements of algebra and geometry; something under 7 percent were being taught elementary chemistry; and under 5 percent were being taught elementary physics.

And this wretched record has further implications beyond simply the failure to produce the professional skills. We live in an age where every side of our daily life touches on physics, chemistry and mathematics. No youngster stepping into maturity can enjoy or, in fact, adequately live in our civilization today without some training in these sciences.

But beyond this essential education of our youngsters is the pressing question of more scientists and engineers. In my view there is a fundamental weakness from the too-prevalent high school system of allowing a 13- or 14-year-old kid to choose most of his studies. Academic freedom seems now to begin at 14.

Better high school preparation essential

A youngster's first reaction in school is to seek soft classes, not the hard work of science and mathematics. Also, he has a multitude of extracurricular activities which he considers more beguiling than hard work. You simply cannot expect kids of those ages to determine the sort of education they need, either for daily living or for the professions, unless they have some guidance.

Once upon a time, our curriculums in high schools provided a minimum of certain essential subjects and still left the youngsters a wide area for supplementary choice. Such curriculums are not strange to our civilization, for they are today insisted upon in our universities and technical institutions as fundamental to the training of men and women.

We are told that there are not sufficient numbers of teachers for even minimum instruction in science in our high schools. We are told that our teachers are underpaid. We are told that there are insufficient elementary laboratories. This is all true.

But if this nation is not to degenerate intellectually and to lose its strength for daily life and defense against our enemies, then the taxpayers, the school boards, and the Parent-Teachers Associations had better wake up.

Now that we have plenty of buses and streetcars, one of the remedies would be to consolidate some of our high schools in more of the larger cities into institutions providing the special training needed to meet the entrance requirements of our universities and technical institutions.

Another remedy is an appeal to engineers and scientists by the school authorities to volunteer two or three lessons a week in the schools of their own localities. Two or three hours a week with eager kids is recreation—not a tax on professional work.

We are also told that the cost of training in our universities and technical schools has risen beyond the reach of sufficient numbers for the national supply. That is also true, and industry is striving generously to remedy the situation.

However, if we are to refill our vacant university and technical institutions which train engineers and scientists, it cannot be done by offering scholarships—as helpful as they are. It requires also sufficient preparatory training for them to enter institutions of higher instruction.

The parents of this country are allowing talented youngsters to be educated as desk workers—a career already overcrowded—at less future pay than they can earn as bus drivers. And this at a time when the scientific professions yield great rewards and great dignity.

But this is an old story to all engineers, and we are grateful to Sputnik and to President Eisenhower for his vigorous statement of this national need.

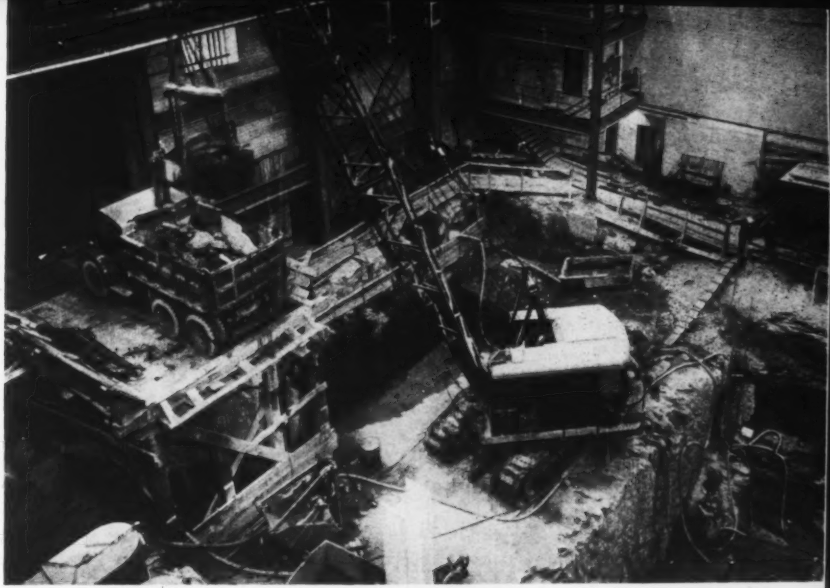
In ending, I will return to the first purpose of this meeting—a proper and stimulating home for the engineers of America.

Dr. Kelly and Mr. Barrett discuss model of United Engineering Center—a ten-million-dollar investment in engineering progress.

UNITED ENGINEERING CE

REUBEN SAMUELS, A.M. ASCE

Treasurer, Thomas Crimmins Contracting Company, New York, N. Y.



Extensions of discharge tunnel on left and intake tunnel on right carry cooling water for additional turbine generator. Note line drilling and broaching for sides of tunnel but line drilling only at end away from operating machines.

Controlled vibration in blasting at close quarters

How to do a particular construction job is often lightly referred to as a "field problem." The second-stage construction for the modernization of the East 74th Street Power Plant of the New York City Transit System presented many complex examples of such field problems to the contractors, Atlas-Crimmins-Carlin, a joint venture. (See article on the first-stage modernization of this plant by Marcel P. Aillery, M.ASCE, in CIVIL ENGINEERING for November 1954, p. 56.)

The overall problem in the second-stage construction was one of limited access and scheduling, large-scale demolition, intricate rock excavation, and concrete construction inside an operating powerhouse. The procedures required are demonstrated by the blasting operations in the intake and discharge tunnel extensions, together with construction of the turbogenerator foundation. See Fig. 1.

Blasting under difficulties

"No blasting will be permitted except where express permission has been granted by the Engineers after receiving a detailed request in writing from the Contractor." This was a prime requirement of the specifications. Preliminary meetings were held with the plant operating personnel, engineers for the designers, and the owners to discuss warnings signals, inspection, and control of the shooting.

As a result of the planning sessions, permission to blast was granted subject to a strict compliance with 19 conditions. These included a warning system for plant personnel; restriction on blasting during the peak load of subway rush hours in morning and afternoon; use of a vibrograph to record the effect of each blast; limitation to ½-lb sticks of 40-percent Dupont Special gelatin, with millisecond-delay blasting caps; checking of the site for stray current before delivery of caps; use of three 10 x 12-ft steel-cable blasting mats as minimum cover for each blast; and specifically stating the explosives loading schedule. The initial allowable load was stated as a minimum of three shooting holes loaded with a maximum of 1½ sticks, or ¾-lb, of dynamite. Increase in charge, for a specific local area, was restricted to a maximum increment of one-half stick, all subject to the approval of the engineers based on vibrograph indications under similar conditions.

As can be seen from the preceding, the entire problem was carefully considered by both owner and contractor. In addition, the contractor brought in an independent seismological consultant to help set up and calibrate the control program, using seismographs.

As shown in Fig. 1, the working area (110 x 75 ft) is wholly within the power plant, and one end of the tunnel excavation is 10 ft from an operating turbogenerator. Work access to the job was through a door, at street level at El. + 16, opening on to 74th Street. The door was 19 ft wide with a 16-ft clear height.

Excavation phase

At the start of excavation, the 70 x 80-ft foundation of the old transformer house was still in existence below El. + 16. The remaining peripheral area was at El. + 4.5, the old basement floor.

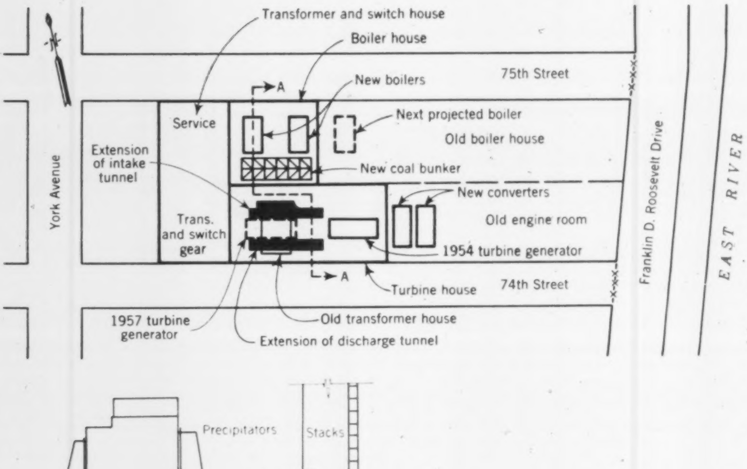
The mass of concrete, earth and rock under the old transformer house was excavated to the + 4.5-ft level using a 2-cu yd shovel that was ramped down to the lower level. Trucks were backed down the earth-rock ramp and loaded on the lower level. As rock was encountered, the careful program of blasting control was instituted.

A Shrader tridimensional vibrograph was maintained in operation throughout the rock excavation work. The vibrograph was used as a direct-reading instrument so that information would be immediately available as each blast was set off. The vibrograph was positioned at various sensitive locations during the blasting in each specific area. These locations included the adjacent turbogenerator, unit substations, the mechanical control room, and adjacent boiler-feed areas.

Individual complaints of excessive

vibration, shock or noise were reviewed and investigated, often by positioning the vibrograph on the desk of the person making the complaint. Through a cooperative effort of the plant operating personnel with the engineers and the contractor, the loading of the holes was controlled for various locations of the working area and continually varied as the depth of rock excavation increased.

The nearest vibrograph check point, the adjacent turbogenerator, showed less vibration effect from the blasting than was found in the plane of rotation of moving components of the generator. The area most sensitive to blast effect proved to be the meters in the mechanical control room, the needles of which acted as low-order seismographs. It should be stated that the blast effect, as studied in the control program, is taken to be the dynamic displacements measured by the vibrograph, and not the more common measure of noise level or shock as perceived by a person who is seated nearby.


Transformer and switch house
Boiler house
New boilers
75th Street
A
Service
Next projected boiler
Old boiler house
Extension of intake tunnel
New coal bunker
York Avenue
New converters
Trans. and switch gear
Old engine room
1954 turbine generator
A
Turbine house
74th Street
Franklin D. Roosevelt Drive
EAST RIVER
1957 turbine generator
Old transformer house
Extension of discharge tunnel
Precipitators
Stacks
Engineering offices
Forced-draft fans
Coal conveyors
60-cycle switch gear
Induced draft fans
Coal bunker
60-cycle reactors
Deaerator
Cable vault and auxiliary equipment
Crane
Boilers
Stairway
74th Street
Scale
Turbine generator
75th Street
Feeder
Evaporator
El +39.5
Mills
Circulating pumps
El +16
Condenser
Boiler feed pumps
El +4.5
El -13.7
Intake tunnel
El -22.5
Discharge tunnel

Section A-A

FIG. 1. Installation of 1957 turbine generator is subject of this article. Note its proximity to 1954 turbine generator and other important parts of the operating power plant. This drawing is revised from that printed in November 1954 "Civil Engineering," p. 57.

The shovel cut was continued to El. 0.0, the bottom of the turbine mat, in the north half and southwest quarter of the working area. This allowed the line drilling and broaching operation for the intake tunnel to start and thus maintain the continuity of the job. At this stage, the shovel loaded trucks standing on the ramp at the southeast corner, and finally it loaded them standing just inside the door as the ramp was blasted out. To remove the last piece of the rock mass in front of the door at the southeast corner, the shovel, which could not reach truck height, loaded the bucket of a rubber-tired front-end loader positioned at the doorway on the street. The loader, in turn, loaded the trucks on the street.

Throughout the operation of excavating to El. 0.0, the line drilling operation was carried out in two shifts following closely behind the excavation. At the completion of the shovel-to-loader-to-truck phase of the work, the Lorain shovel was converted to a crane with a 60-ft boom. In addition, a platform was constructed at street level, with supporting bents straddling the discharge-tunnel excavation.

The crane was then positioned between the tunnels and blasting was commenced in both tunnel cuts, working from west to east. The crane placed the protective mats over the loaded shooting holes and also dug and loaded the rock muck into trucks on the platform at the doorway. The crane functioned in this manner until a shallow cut had been made in both tunnels.

The next and final equipment change for the excavation work was to rig the crane with a three-part cable to efficiently handle heavier lifts. A 2½-cu yd Traxcavator front-end loader was brought into the tunnel areas to muck the deeper rock cuts. This equipment combination completed the tunnel excavation. The crane continued to handle the blasting mats. The front-end loader mucked the rock, placing the material in 3-cu yd bottom-dump "battleship" buckets, which were lifted out of the cuts and loaded into trucks by the crane. Both tunnels were worked simultaneously, the front-end loader being lifted back and forth by the crane.

A total of 3,200 cu yd of rock was excavated using an average of less than 1 lb of dynamite expended per cubic yard.

Concreting phase

When the rock excavation was completed at the west end of each tunnel, concreting was started while intricate rock excavation on the east end, adjacent to the existing tunnels, continued.

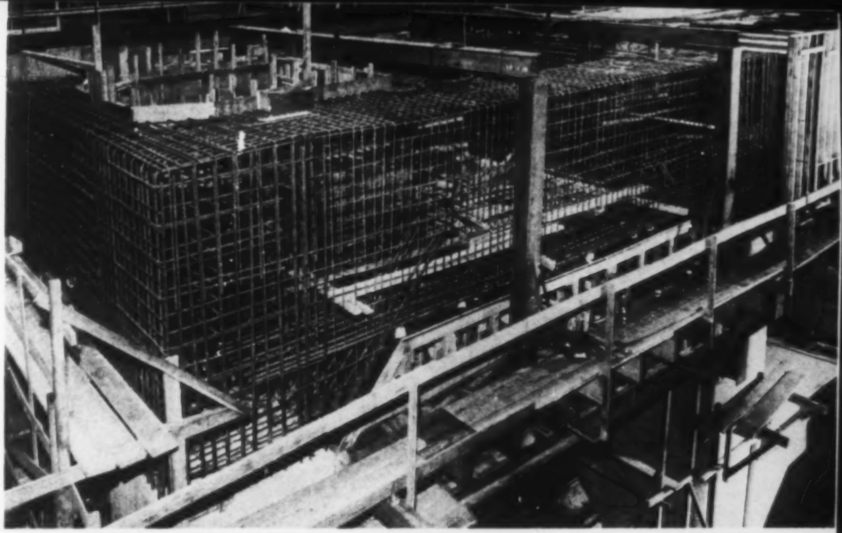
With the crane maintained in its position between the tunnels, all excavation work was completed and all tunnel concrete placed with the exception of the intake-tunnel roof. The crane was then positioned on cribbing on top of the discharge tunnel roof at the south end of the working area. From this location the crane was used for placing concrete in the complicated baffle structure of the intake tunnel, in the intake tunnel roof and roof structures, and in the turbine mat.

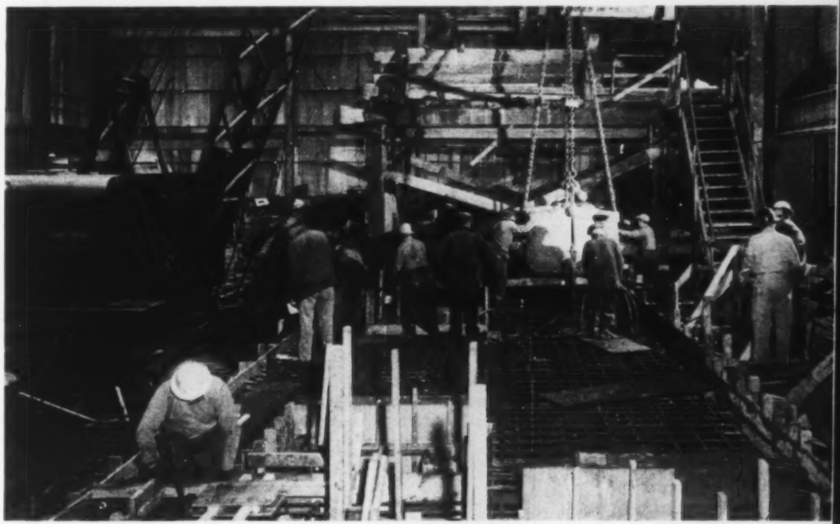
Because of the massive nature of the turbogenerator foundation (it contains 585 cu yd of concrete and 55 tons of reinforcing steel), the crane was used throughout in the handling of form material, reinforcing bars, and concrete. The cribbing supporting the crane on top of the discharge tunnel was raised as required by the progress of the turbogenerator foundation pours. The crane was worked back and forth on increasingly higher blocking until it had been raised from the El. 4.5 level of the tunnel roof to El. + 16 at the doorway platform.

From the initial rock excavation to the last turbogenerator pour, this work took about ten months. Considering the relatively small quantities involved—3,200 cu yd of rock and 2,360 cu yd of concrete—this is a measure of the complex nature of the step-by-step operations required.

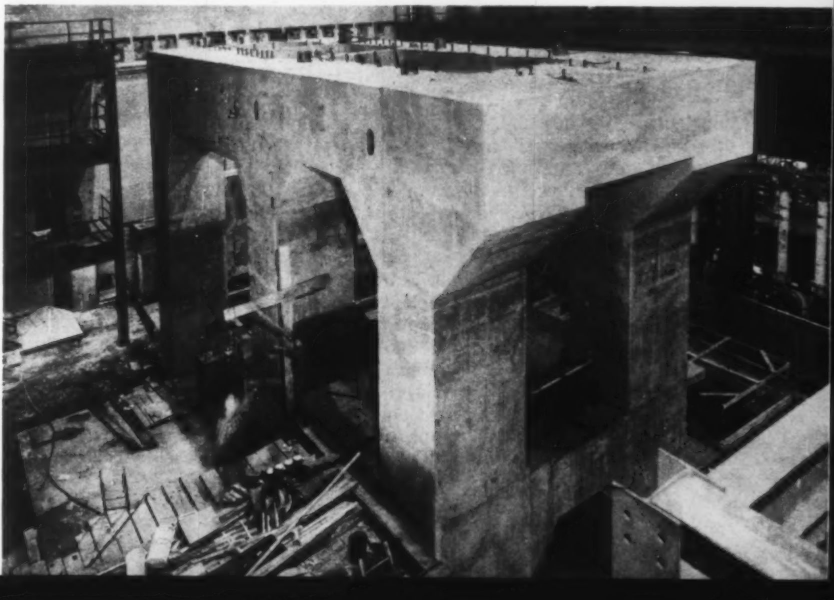
George T. Tzougros directs the technical supervision of the Power Construction Program for the New York City Transit Authority. The J. G. White Engineering Corp. handled the engineering, design and supervision of construction of the entire plant modernization program, this portion of which was under Marcel P. Aillery, M.ASCE, Chief Structural Engineer. S. C. Willis, M.ASCE, is Resident Manager for White on the current work.

Robert Crimmins, A.M.ASCE, A. Holmes Crimmins, Edward E. Lustbader, A.M.ASCE, and P. J. Walshe are the administrators for the joint venture of Atlas-Crimmins-Carlin. Nathan Brenner, A.M.ASCE, is Project Manager; Sidney Gottfried is Project Superintendent; and Jack T. Walle is Excavation and Concrete Superintendent.





Reinforcing for the turbogenerator was accurately and rigidly fixed in position. Top photo vividly illustrates field problem that arises where designers fail to leave space somewhere for worker access. In photo immediately above, crane uses muck bucket for placing ready-mixed concrete. "Closing line" on crane opens bucket; chain across end of bucket controls opening and flow.



Plywood-faced forms give pleasing appearance to massive concrete of turbogenerator foundation.

Los Angeles enlarges its sewage facilities—Part 3

Two long ocean outfalls

DAVID L. NARVER, Jr., M. ASCE, Project Manager

E. H. GRAHAM, Jr., A.M. ASCE, Assistant Project Manager

Large increases in population, and consequently in quantity of sewage to be handled, have made it necessary for Los Angeles to provide a corresponding increase in the capacity of its sewerage and treatment system. In their article in the November issue, the authors described the new land outfall, eight miles long and mostly in tunnel, with a capacity of 354 cfs when flowing three-fourths full. This outfall feeds into the Hyperion Treatment Plant, which of course had to be expanded to handle the increased load, as described in the December issue. This third and final article in the series explains the design and construction of the two ocean outfalls, which complete the present program.

Disposal of sewage into the ocean has been practiced for centuries, but not for effluent that has received only primary treatment and still is required to meet very rigid health and water pollution requirements. The two ocean outfalls for the Los Angeles Hyperion Treatment Plant—one for sludge and one for effluent—involved what are believed to be the most extensive studies ever made for a single project of this kind.

The requirements established were the result of a study by State of California authorities that required more than a year. These requirements are much more stringent than those for any other ocean outfall in the state and far more restrictive than had been envisioned at the time the design was begun. The final requirements were issued in May 1956, and minor modifications were made as late as November 1956, which was after the design was well under way. To meet the new regulations, a complete design review, and some modifications, were necessary. Major requirements are summarized in Table I.

Oceanographic and bacterial studies

A check of available data on conditions in Santa Monica Bay indicated that almost no scientific facts were known but that a great many "tales" were in circulation. To get the oceanographic data needed for the design, a contract covering over a year's cycle of the bay was awarded to the Allan Hancock Foundation of the University of Southern California. The work performed by the Foundation cost over $222,000 and included detailed studies of currents, geology, strength of bottom sediments, salinity distribution, water temperature, eddy diffusion rates, marine biology, beach and bottom erosion, and a multitude of other details needed by the designers.

During the preparation of the design, it became evident that the requirements could not be met by dilution alone, so the Foundation studied E. Coli disappearance rates in large quantities of sewage released into a salt water mass. The rate of disappearance rather than the death rate was used because it was not possible to tell accurately how many died, settled out, or were devoured by marine life. Nearly all previous work along this line had been performed in laboratories. However, the experiments made by the Foundation, using three existing sewage ocean outfalls, showed that much of the laboratory work was not valid, and this caused further complications in the design of the ocean outfalls.

To determine some of the unknowns in both E. Coli disappearance rates and current velocities, a radioactive tracer (20 curies of Scandium 46) was released a mile offshore over a period of one hour. Of the 21 available tracer elements studied, Scandium 46 was chosen because it met the scientific requirements, was satisfactory from the health standpoint, had a short half life, and was not prohibitive in cost.

While the oceanographic studies were progressing, the design personnel for the ocean outfalls were investigating all available data concerned with ocean disposal and were touring the east and west coasts of the country looking at, and asking questions about, construction methods and the effectiveness of existing outfalls. Once again the available information was found to be very meager, and observation of existing outfalls was very important.

By judicious use of the formulas of Ketchum-Carey-Biggs, Rawn-Palmer, Brooks, Houghton-Mason, Pomeroy, and Conway, charts for the effluent ocean outfall similar to Fig. 1 were developed. The charts were prepared on the assumption that the diffuser would be in 200 ft of water and 5 miles from shore, with an average E. Coli bacteria count of 600,000 per milliliter. From these charts, it was possible to ascertain quickly what combinations of current velocities, direction, and bacteria disappearance rates could be allowed in the bay without exceeding the health standards. The governing conditions for the sludge ocean outfall were somewhat different and will be discussed later.

Since large amounts of public money were to be invested in the effluent ocean outfall, assurance that the scheme would work was of paramount

constructed

Hyperion Engineers, Los Angeles, Calif.

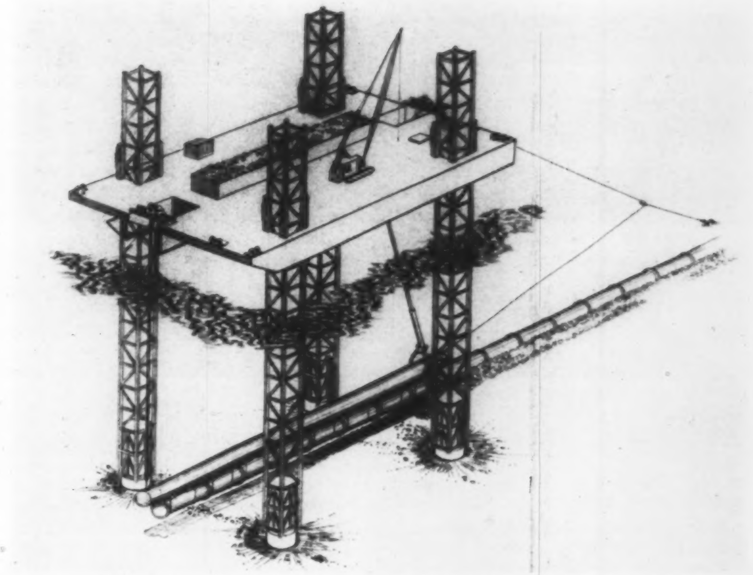
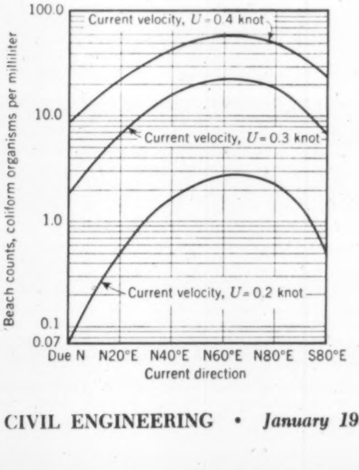


FIG. 2. Mobile platform is used to lay concrete pipe of 12-ft diameter for effluent outfall. When platform is to be moved, barge is lowered until it becomes buoyant. Then legs are jacked up and it is towed to next position, where legs are jacked down again to provide firm support in water up to 195 ft deep. Note pontoons in leg bases, pipe-type pontoon to which pie sections are attached while being swung into position under platform, and forked pipe for depositing crushed rock around outfall.

importance, and several safety factors were incorporated in the design. The two most important were conservative E. Coli disappearance rates and conservative current rates. Obviously, the longer it takes for the bacteria to disappear, the more likely it is that the bacteria count on the beach will be high. Further, the faster the shoreward velocity of the currents, the sooner the sewage will reach the beach and the higher the bacteria count will be there. The Foundation's study of E. Coli disappearance rates showed that a reduction in magnitude could be expected every 4 hours, so a magnitude reduction every 8 hours was used in the design.

As for current velocity, the maximum found in the bay regardless of direction or depth—0.5 knots—was assumed to be the current velocity directly toward the shore for the full depth of water. Actually, the maximum surface current was 0.5 knots and the maximum bottom current approximately 0.1 knots, so an average maximum velocity of 0.3 instead of 0.5 knots would have been reasonable. It should also be pointed out that the prescribed bacteria counts may be exceeded 20 percent of the time, and the maximum current condition is expected only 2 percent of the time. This gave an additional safety factor.

FIG. 1. Many charts similar to this made it easy to compare various diffuser schemes for effluent ocean outfall to meet health standards.



Effluent ocean outfall

As soon as the designers had assured themselves that the basic con-

TABLE I. Major requirements for two ocean outfalls

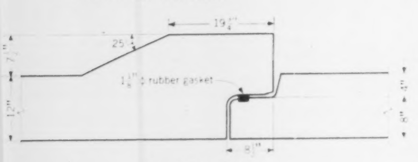
Item	Area 1	Area 2	Area 3	Shore
1. Distance from origin, ft	0 to 7,500	7,500 to 22,000	22,000 to 42,000	1,500 ft from H.W.L.
2. Max. Coliform organisms, MPN (Most Probable No.) per milliliter	No limit	Geometric mean of a sampling sta. in Areas 2 and 3 to be less than 100		10
3. Min. dissolved oxygen	6 ppm	....	....	....
4. Max. grease	2 ppm	....	....	None
5. Recognizable floating or suspended sewage solids	None	None	None	None
6. Transparency using Secchi disk, ft	No limit	More than 20	More than 20	....
7. Organic content of bottom samples:				
a) Total	No limit	Less than 50%	Less than 50%	....
b) Annual increase of	No limit	Less than 3%	Less than 3%	....
8. Noxious odors, grease, or fumes	None	None	None	None

Note: Recognizing an occasional exceptional condition, the requirements allow the above to be exceeded by 20 percent in any 20 consecutive samples.

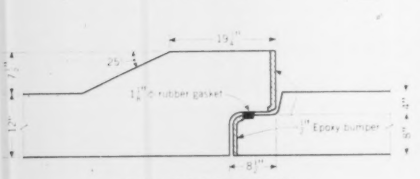
cept of disposal of primary treated effluent at a point 5 miles offshore was valid, detailed designs were begun. An economic study of pumping costs versus pipe size showed that a main-stem pipe of 12-ft inside diameter, which could withstand an internal pumping head of 121 ft, would be the most economical. Once the size of the main stem had been decided, simple hydraulics dictated that the pair of diffusers should have an inside diameter of 8½ ft at the Y-structure. These in turn should be reduced to an inside diameter of 6 ft and then of 4 ft, depending on the flow at the particular cross-section. The 4-ft size was eliminated because of the difficulty of providing a satisfactory cleaning device that could be used both for the 8½-ft size and the 4-ft size in water 200 ft deep.

Two diffusers set at an angle of about 120 deg were chosen because this gave the best distribution of sewage into the bay, regardless of current direction. Diffuser length was based on the number and spacing of outlet ports. From previous experience, it was determined that the most acceptable port diameter would be about 7 in. To obtain relatively equal flow from each port, diameters of 6¾, 7¾, and 8⅛ in. were used for the ports in the final design. The smallest size was used nearest the wye where the head was greatest. Computations showed that fifty 6¾-in. ports, twenty-one 7¾-in. ports, and twelve 8⅛-in. ports were required. The ports were so spaced that the rising cones of diluted sewage, under normal current velocities, would not intersect at the surface of the bay.

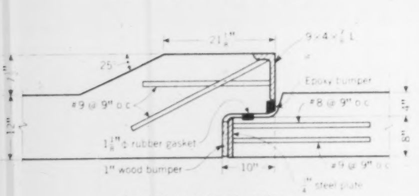
FIG. 3. Four permissible basic pipe joints were specified for 12-in.-wall pipe in effluent outfall.



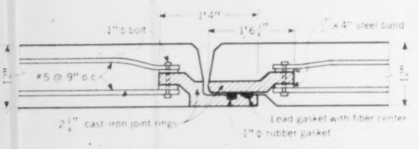
LAID FROM TRESTLE



LAID WITH STATIONARY EQUIPMENT



LAID WITH FLOATING EQUIPMENT



LAID WITH STATIONARY OR FLOATING EQUIPMENT

The calculated cone diameter at the surface was 50 ft. To save pipe length and to help balance forces, the ports were alternated from the spring line on one side of the diffuser to the spring line on the opposite side. Another consideration in the spacing of ports was to place them so that they would come at the same location in standard precast pipe sections whether 12 or 16 ft in length. Taking all these factors into account, the ports were spaced every 48 ft. This spacing in turn established the diffuser length of 3,936 ft.

The gravity-flow capability of the final design is about 300 mgd. This value, as well as the pumping head for all flow over 300 mgd is of course dependent upon the *n* value of the pipe. The design value of *n* was 0.017 for the 12-ft-diameter pipe and 0.021 for the diffuser, allowing for quite a bit of accumulated matter on the inside. For this reason, careful consideration was given to maintenance, particularly cleaning of the line. For possible repair or inspection, manholes of 3-ft diameter are placed about every 500 ft. These manholes can also be used to divert the effluent flow if it becomes necessary to repair the outfall in deep water.

To clean this 12-ft-diameter pipe, a section of large pipe is run completely through the Y-structure, at the end of which a removable concrete bulkhead is placed to stop the flow. When this bulkhead is removed, a cleaning device can be inserted immediately oceanward of the pumping plant and run the length of the main stem and out through the wye. To clean the diffusers, provisions have been made in each diffuser, adjacent to the wye, to insert a bulkhead and thus force all the flow through the other diffuser. At the same time, bulkheads at the outer ends of the diffusers can be removed. The maintenance personnél then have the option of using the increased flow through a single diffuser to scour out any sedimentation, or of plugging the ports and running a cleaning device the length of the diffuser.

Drawings and specifications allowed the bidding contractors a wide latitude in methods of construction. Four basic types of acceptable joints and several variations of each type were detailed. The specifications stated that no substitution or modification of joints would be acceptable until after award of contract. The reinforcing and thickness were given for lengths from 10 to 100 ft for non-stressed pipe and up to 300 ft for post-tensioned pipe. For lengths greater than 300 ft, design requirements were established and the contractor could submit a design for approval, providing his method of laying the pipe was compatible with the design.

The intent was that the drawings and specifications would indicate the desired final product, not the method of achieving it. However, all bidders had to submit with their bids a brief outline of the proposed method of construction. Deviations from this proposed method could be secured after award by having the new method checked and approved by the engineers. This was necessary so that provisions can be made for proper inspection.

The four basic types of allowable subaqueous mated joints are shown in Fig. 3. The estimated costs varied from $5,500 for each cast-iron ball-and-socket joint to $200 for each plain concrete joint. Depending on the stability of the laying platform, and the length of pipe being laid, the following joints were allowed:

TYPE	PLATFORM	LENGTH, FT
Plain concrete	Stable	10 to 24
Steel armored	Floating or stable	10 to 300
Plastic	Floating or stable	10 to 300
Cast-iron with anodes	Floating or stable	10 to 96

Joints that can be mated out of the water may be plain concrete, because special subaqueous joints were required only to protect the pipe from the large forces that can occur when it is swinging from a length of cable.

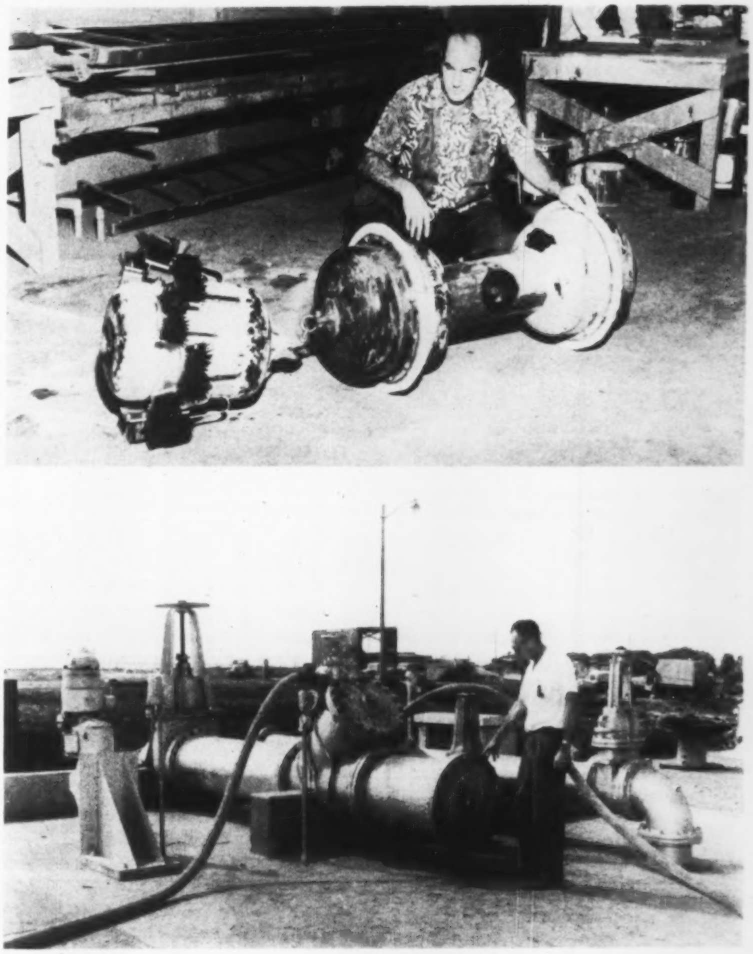
All joints have a rubber gasket to assure a good seal and minimum leakage under any pressure condition. Except for the cast-iron joint, this gasket is always in a concrete groove and so situated that corrosion of the iron will not hamper the sealing action. No corrosion was anticipated in the cast-iron joints because they would be cathodically protected by a zinc anode attached at every such joint. A lead gasket is furnished with each cast-iron joint but need not be used unless the leakage tests are not met.

All the pipe is of reinforced concrete. The reinforcing bars are to conform with ASTM Designations

A15 and A305 except that the maximum carbon content is 0.30 percent; the ultimate tensile strength, from 60,000 to 90,000 psi; and the minimum yield strength, 36,000 psi. The concrete is to have a compressive strength of 5,000 psi and a flexural strength of 600 psi at 28 days. The cement is to be Type II, containing not more than 0.6 percent of total alkali. A large steel cylinder pipe was considered but the problem of cathodic protection made its use unreasonable as compared with pipe that did not require such protection.

Because of the strict water pollution limitations, leakage is a very important factor. Tests for the pipe are required in the yard, for subaqueous mated joints in the final position, and for all other joints at the time the joint connection is made. In addition, a sufficient number of joints must be yard tested to assure the City that the joint, as manufactured, is satisfactory. The yard tests allow a maximum leakage of 1 gal per hour when the pipe and joint are subjected to the design head (20 to 45 psi depending upon the distance from shore for that particular section of pipe). For the in-place tests, the test pressure and the allowable leakage rate vary with the anticipated pumping pressure head and the distance from shore.

		Max. Allowable Leakage Rate	
Section Station	Test Pressure	Per Joint, gal per hr	Cumulative, gal per hr
0 + 03 to 50 + 00	40 psi	10	1,000
50 + 00 to 100 + 00	35 psi	15	1,500
100 + 00 to 150 + 00	30 psi	20	2,000
150 + 00 to 200 + 00	25 psi	30	3,000
200 + 00 to 275 + 07	20 psi	50	8,000



Cleaning device for 22-in. diameter sludge ocean outfall (top photo) is inserted on roof of sludge pumping building (lower photo). Device is fed into upper part of wye and forced down into main flow by small pressure hoses.

Design of the effluent ocean outfall was completed in December 1956, and bids for its construction were received on May 15, 1957. The contract was awarded to Hyperion Constructors, a joint venture of Raymond Concrete Pile Co., DeLong Corp., Healy Tibbetts Construction Co., Peter Kiewit Sons Co., Macco Corp., and Tavaris Construction Co., for $20,279,000. The allowable construction time is one thousand days.

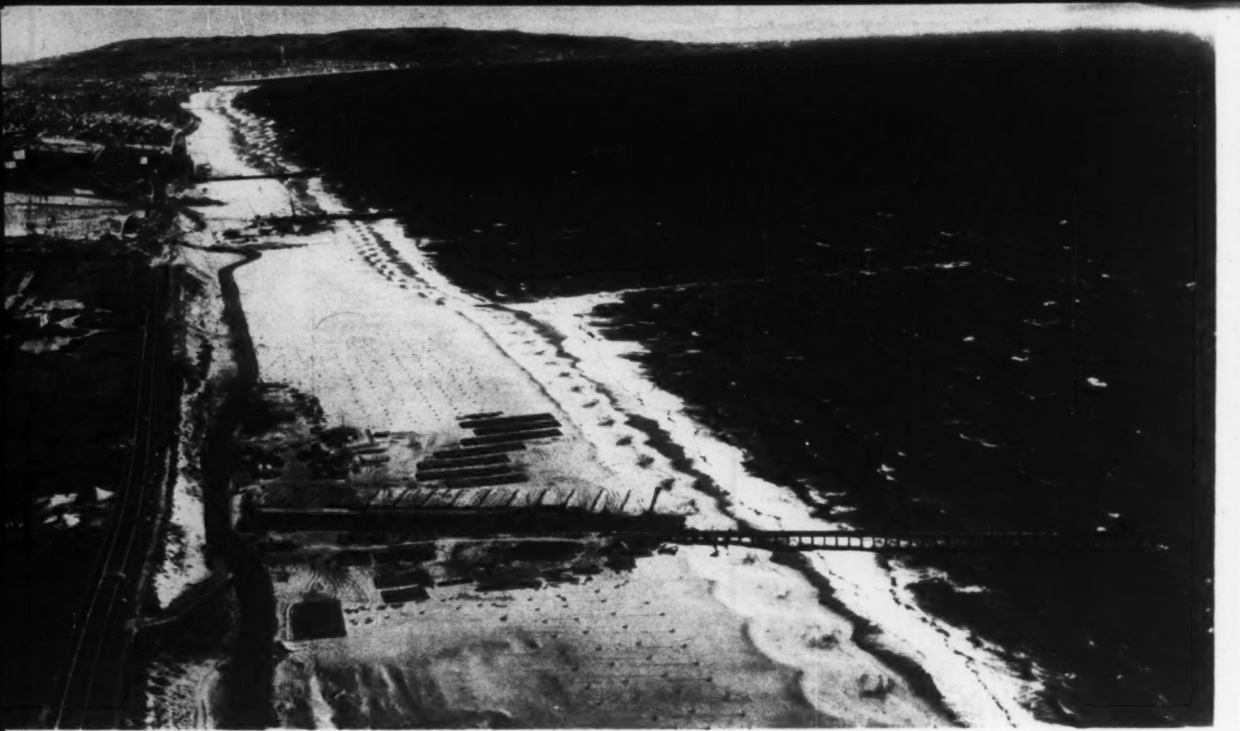
Laying large-diameter pipe

The contractor's method of laying this 12-ft-diameter pipe is interesting. The first 4,000 ft (which is the distance the pipe is buried) will be lowered into position by a gantry crane inside a trestle. For the first 1,200 ft of this distance (up to an ocean depth of − 13 ft), a sheetpile cofferdam will be used. Beyond this point a trench wide enough to eliminate the need for sheetpiling will be excavated. The trench will be overexcavated about 2 ft in depth and the pipe will be hung to grade in slings attached to the trestle until backfilling has been completed. The slings will then be removed. This method not only avoids additional excavation for each bell, but also facilitates keeping the pipe at grade.

The remaining 31,500 ft of the outfall, which goes out to depths of 195 ft, will be laid from a mobile platform being built specially for this job, as shown in Fig. 2. This platform will be designed on the principle of the "Texas tower," the legs being used to jack the barge out of the water at each stopping place, thus providing a stable platform from which to lay the pipe.

There will be a gantry crane at each end of the platform and a gravel hopper, of 1,200-ton capacity, in the mid portion. The platform will be 122½ ft wide, 190 ft long, and 17 ft deep, and will weigh about 1,700 tons. The platform legs, 275 ft high and 16 ft square in cross section, are made up of heavy structural sections, each leg weighing 700 tons. In the base of each leg there is a pontoon 13 ft in diameter and 40 ft high. The four jacks on each leg have a 32-ft throw.

To lay the pipe, eight sections each 24 ft long are first attached to the under side of a steel-plate pontoon, which is then floated under the placing platform, as shown in Fig. 2. The submerged weight of this length of pipe is about 350 tons. The pontoon is 212 ft long, 14 ft in diameter, and has a plate thickness of 1 in.



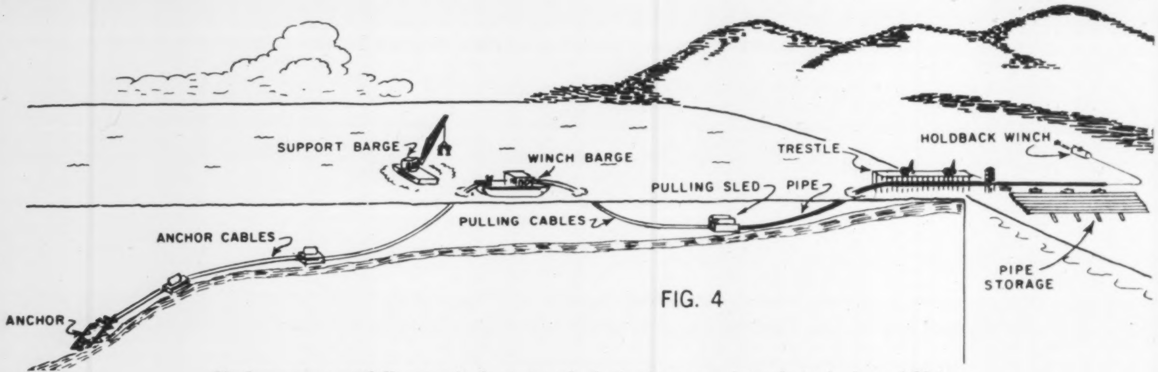


FIG. 4

Sludge ocean outfall, seen in foreground of air view, consists of steel pipe of 22-in. O.D. Pipe was purchased in 40-ft lengths and welded into 600-ft lengths, seen lined up on beach parallel to final alignment. Schematic sketch, Fig. 4, shows method by which 7-mile length of sludge line was pulled into place in one continuous operation in 7½ days.

When the assembly of pontoon and pipe sections has been floated under the platform, the pontoon is attached to the gantry cranes and then flooded. The cranes lower the pontoon until the pipe hung below it is within one foot of the natural bottom, where haul-in lines pull the new section of pipe into the bell of the section previously laid.

While the pipe is held a foot above the bottom, gravel is deposited through a Y-shaped tremie up to the spring line of the pipe. The next step is to disconnect the pontoon from the pipe, haul it to the surface, dewater it, and tow it back to pick up more pipe.

Next the mobile platform must be moved forward. First it is lowered into the water until it becomes buoyant, and the legs are jacked up high enough so that it can be winched to a position 192 ft further along the line. The platform is then jacked up in the air ready to receive another 192 ft of pipe. This process will go on around the clock. According to the present schedule, pipe laying will commence in May 1958 and will be completed in March 1959, over a year ahead of schedule.

Sludge ocean outfall

Design considerations for the sludge ocean outfall differed from those for the effluent ocean outfall. The sludge outfall needed an inside diameter of only 20 in. to handle a peak capacity of 6.5 mgd at a 250-ft head. However it would be carrying a very turbid material and it was desirable that the fluid should not reach the surface. The services of Dr. Norman H. Brooks, J.M. ASCE, of the California Institute of Technology were secured, and the temperature and salinity of the water of the bay were carefully reviewed. It was determined that if the sludge came out the end of the pipe without the aid of diffusers, it might rise to a height of 250 ft in sea water. The sludge, being suspended in warm fresh water, would rise so quickly that there should be little or no sedimentation at the end of the pipe. As the fresh water rises, it becomes diluted with salt water, reducing the temperature difference and the velocity. Before the sludge reaches a height of 250 ft, the velocity should be such that the heavier particles will begin to settle out, and the rest of the sludge will reach a state of equilibrium and the finer particles will tend to spread out and follow the currents. To provide a safety factor, the final design depth was set at 300 ft. (The actual in-place depth is 320 ft.) This depth was provided by running the pipe over the edge of the under-water Santa Monica Canyon, some 7 miles at sea from the Treatment Plant.

On July 23, 1956, a $2,629,044 contract for the sludge ocean outfall was awarded to the Healy-Tibbetts Construction Company, allowing one year for completion. The construction drawings and specifications permitted either of two basic types of construction—reinforced concrete pipe or cathodically protected steel cylinder pipe. The successful contractor elected to use the steel pipe because he planned to lay it by pulling it into place.

The cylinder pipe used is basically API 5LX-52 pipe with an outside diameter of 22 in., a 3/8-in. wall, and a 1/2-in. mortar lining. The exterior coating consists of a layer of coal tar and three wrappings of fiber glass, providing insulation from the salt water to reduce the electrical current required for cathodic protection. Outside the coal tar, a 1 1/8-in. thickness of gunite was applied, providing protection against abrasion due to drifting sands and adding sufficient weight to keep the outfall from floating even if the pipe should become emptied of sludge. This latter condition could occur if a sudden pump failure should produce a vacuum before the momentum of the moving water could be overcome and the water mass stopped and reversed. No leakage was allowed at 130 psi. Except for the buried portion, the pipe is held in place by anchors every 500 ft. Each anchor consists of a 14 1/2-ft length of chain with a concrete block (4 x 3 1/2 x 2 1/2 ft) at each end.

The manner of construction, novel in the sanitation field, is based on the ability of the contractor's equipment to pull all 7 miles of pipe as one continuous string. This is shown schematically in Fig. 4. The contractor accomplished this feat by purchasing the pipe in 40-ft lengths and having it lined and coated before delivery to the beach. The working area on the beach extended only 650 ft from the water to a road that had to be kept open. The 40-ft lengths of pipe were lined up parallel to the final alignment and welded into 61 sections, each 600 ft long.

At the same time, an anchoring system capable of holding 500 tons was being set up 9 miles offshore in a water depth of over 650 ft. A trestle 1,000 ft long was constructed outward from the beach. A series of rubber-tired dollies, set approximately 40 ft apart, extended from the road on the inshore section to the end of the trestle, thus forming a carrier approximately 1,600 ft long and set on a minimum vertical radius of 3,000 ft. The dolly at the end of the trestle was in the water. The head end of the pipe was plugged to keep it filled with air, thus decreasing the in-the-water weight to 4 lb per lin ft.

When everything was ready, a 600-ft section was rolled onto the dollies and then along the dollies until the head end was 700 ft out on the trestle. The next 600-ft section was then rolled onto the dollies and along them until it came into contact with the first section. The tail end of the first string was then connected, as will be described later, to the head end of the second string. As soon as the connection had been made, this 1,200-ft section of pipe was pulled out over the dollies into the water and along the bottom. The pulling stopped when the tail end of the 1,200-ft section arrived at the same position the head end had occupied before the pulling started. The third and fourth 600-ft sections were then rolled out, connected, and this second 1,200-ft section was pulled out.

The pulling was accomplished by two 2-in. stranded wire cables connected to a two-drum, 500-ton winch mounted on a barge. Each drum had a cable capacity of 2,500 ft, and there was always another 2,000 ft of cable between the winch and the end of the pipe to assure that the pulling cable would be horizontal at its point of connection with the pipe. This placed the winch between 2,000 and 4,500 ft from the end of the pipe. The offshore side of the winch was fastened to a pair of cables running out to the anchoring system 9 miles offshore. The winch would pull two 1,200-ft sections out and then let off 2,400 ft of cable from the winch while the barge moved 2,400 ft farther offshore. The barge would then be in position to pull out another 2,400 ft of pipe.

Considerable thought was given to the connection between the 600-ft lengths of pipe because it would be virtually impossible to place the 1/2-in. interior mortar lining with human labor without a very elaborate ventilation system. The ideal solution would be to make up the joint without putting anyone inside the pipe. This was done by making an epoxy resin sleeve about 14 in. long, which was custom cut for each joint. (The interior lining had been left off 7 in. back from each pipe end so as not to interfere with the welding of the steel pipe.) The inside of the pipe, where the sleeve would be, was buttered with a workable epoxy resin. The sleeve was then inserted into one section of pipe and the other section was pulled over the sleeve until the steel of both sections was in contact.

Excess buttering that oozed into the interior of the pipe was spread along by a ball that had been left in the offshore part of the pipe and was pulled across the joint by an inshore haul line. The two steel-pipe sections were then arc welded together, without detrimental effect on the sleeve, the weld being given a 360-deg inspection by X-ray. The outside of the pipe was then coated with coal tar, wrapped with fiber glass, and gunited as soon as the coal tar had set.

The time required to place a 1,200-ft section varied from 4 1/2 hours to 15, depending on the ability of the construction crews and the minor difficulties that arise on any job. Work proceeded 24 hours a day, and in 7 1/2 days all the pipe to be placed on the ocean floor had been pulled. A few days later the pipe on the trestle was dropped to the bottom.

To protect the pipe from possible bottom erosion, it was deemed necessary to bury the inshore part of the outfall. The depth the pipe was buried varied from 20 ft at the shore to nothing at a distance of 5,900 ft offshore. Most of this burial was accomplished by a patented jetting device that rode the pipe. In the surf zone, sheetpiling was driven and the sand excavated in order to lower the pipe.

It may be of interest to mention, in connection with the cathodic protection, that the 7 miles of pipe in the ocean is requiring only 20 milliamperes of electrical current, even though some 200,000 sq ft of steel surface is being protected.

Louisiana's new ocean-river port

JOHN D. M. LUTTMAN-JOHNSON, M. ASCE

Transit shed, 625 x 200 ft, has single row of columns 25 ft on centers down the middle. Clearance under roof trusses is 20 ft.

Ship at grain wharf is being loaded with export cargo. Grain arrives in river barges which are berthed on shore side of wharf. They discharge through a marine leg to conveyor feeding into grain elevator 850 ft distant, on land side of levee.

At the head of deep-water navigation on the Mississippi River, some 225 miles inland from its mouth, a new ocean-river port has recently been completed at Baton Rouge, capital of Louisiana. This initial stage of a $50,000,000 long-range development program will provide the Baton Rouge area with modern port facilities capable of accommodating deep-water vessels and river barges. Its ability to transfer large volumes of liquid, bulk, and packaged goods between barge and ship, or to storage, is already changing transportation patterns in the South.

These facilities are not only modern in design but also extensive. They include a large general cargo dock with a frontage of 1,355 ft; a central transit shed 625 by 200 ft; a 2½-million-bu grain elevator and ship loading dock, complete with conveyors and grain handling equipment; an 8-million-gal molasses tank farm; a water supply system; supporting railroad tracks and yards, highways, and other appurtenances.

Consummation of this initial program required much vision, thought, planning, and hard work by those most directly concerned, and demonstrated the effectiveness of coordinated teamwork, involving such professions as engineering, law, finance, politics, and business and commerce in a variety of forms.

In March 1953, Fay, Spofford & Thorndike, Inc., of Boston, Mass., and Barnard and Burk of Baton Rouge, were engaged by the newly created Greater Baton Rouge Port Commission to prepare an engineering-economic feasibility report and master plan covering the proposed development. During the succeeding 18 months, investigations were carried out and studies made of the many engineering and economic factors entering into the overall feasibility and planning of the project.

Site selected

It was early determined that the best available site was on the west bank of the river immediately south of Port Allen, which lies across the

225 miles from the Gulf

Senior Engineer, Fay, Spofford & Thorndike, Inc., Boston, Mass.

river from downtown Baton Rouge. At this point the Mississippi is 2,000 to 2,500 ft wide between levees and up to 70 ft deep at Mean Low Water, which is 2.5 ft above datum, or Mean Sea Level in the Gulf of Mexico. Tops of levees are at El. +50 minimum, while the maximum flood stage predicted is El. +46.50.

This site was selected for several reasons:

1. The land adjacent to the river was undeveloped pasture and could be purchased at a relatively low cost.
2. The natural deep-water channel of the river lies close to the west bank, which is relatively stable.
3. Proximity to the proposed Indian Village-Port Allen Cutoff Canal of the Intracoastal Waterway would provide an opportunity to integrate the port and canal developments.
4. Three of the four trunk-line railroads now operating in the Baton Rouge area run close to the site.
5. Highway connections are good and their further improvement is planned.
6. Navigation conditions for ships and barges are favorable, and the large anchorage area has ample water depth even during minimum river stages.

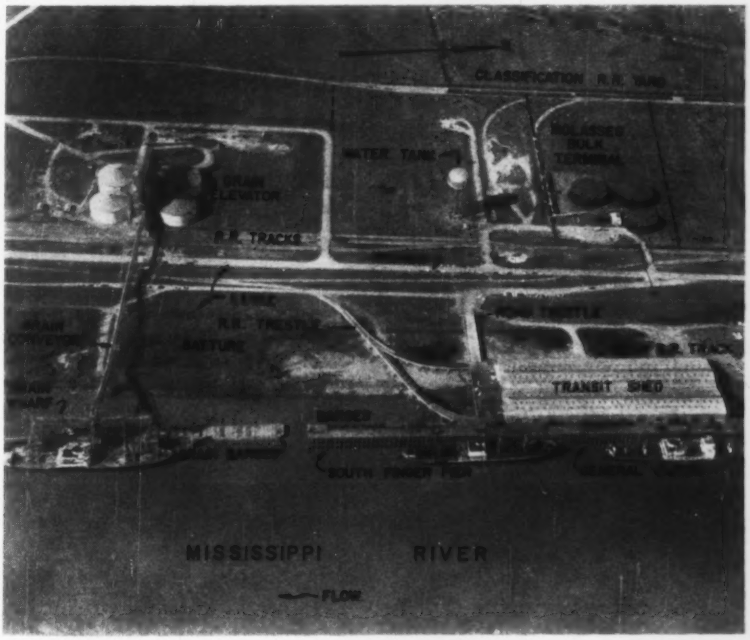
Accordingly, the Commission purchased some 350 acres of pasture land at the selected site, with 6,000 ft of deep-water frontage on the river. This area was laid out so that it was bounded on the west by Louisiana State Highway No. 168, on the north by the town of Port Allen, on the east by the Mississippi River, and on the south by the locks (now under construction) of the extension of the Plaquemine-Morgan City Alternate Route of the Intracoastal Canal, commonly called the Indian Village-Port Allen Cutoff Canal. This location will make the new port a junction point for barge traffic on this section of the Inland Waterway System, which extends northward to Minneapolis and the Great Lakes, eastward to Florida and the Atlantic coast, and westward to the Mexican border.

Meanwhile topographical and hydrographical surveys of the selected site were carried out; test borings and soil analyses undertaken; engineering, layout and structural design problems studied; potential traffic and other sources of revenue investigated; methods of financing considered; and tentative operating agreements worked out with four railroads to service the port. In addition, a vast number of collateral engineering, economic, and operational problems attending the project were investigated and solutions formulated.

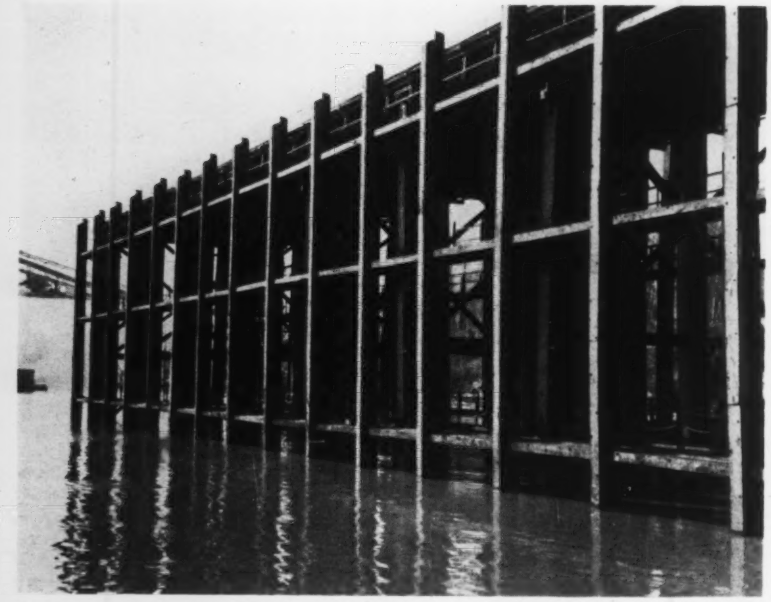
Apart from the work done in the Baton Rouge area, investigation and research on traffic potentials extended from New Orleans in the south to Minneapolis and Chicago in the north, to Kansas City in the west, and to Boston and New York in the east. Prospective lessees of bulk handling facilities were contacted and tentative agreements worked out for the operation of a grain elevator and a molasses tank farm. In September 1954, the master plan and report of the consulting engineers were published.

Initial development

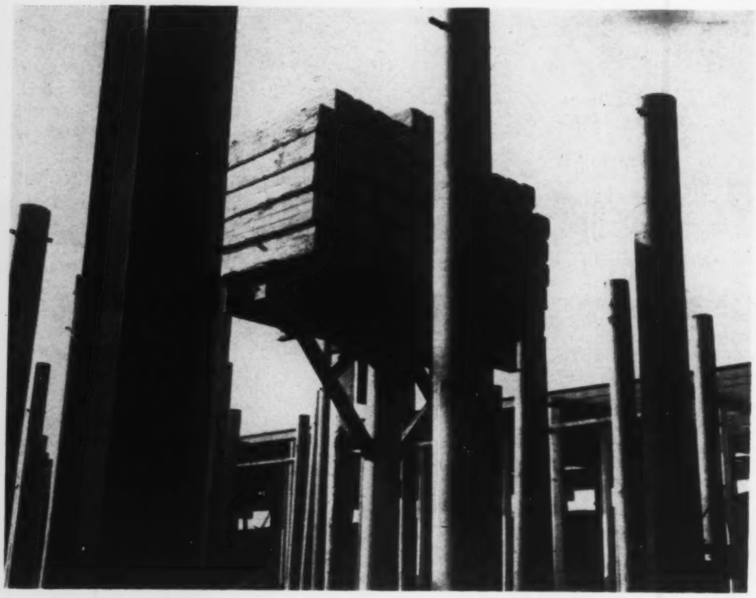
The report established the engineering and economic feasibility of a project covering an initial development on the west-bank site at an estimated cost of $12,500,000. Financing was to be through the sale of revenue bonds having a 40-year life and an assumed interest rate of 3½ percent. However, when the bonds were placed on the market in October 1954, interest rates



New ocean-river port development is at head of deep-water navigation on the Mississippi—225 miles from Gulf of Mexico. Baton Rouge, La., is on opposite side of river in this view, looking west. River is 2,300 ft wide here, at end of 35-ft navigation channel.



Flexible fender system 55 ft high, at downstream end of South Finger Pier, has Greenheart timber on wearing face and rubber at points of bearing.



In pile load-bearing test at general cargo wharf, load of 400 tons is applied. Pile No. 35, 152 ft long with 33-in. O.D., settled 0.95 in. and recovered to 0.25 in. when load was removed. Super H-pile in left foreground consists of two 30 WF 108 and one 36 WF 150 welded together. Hammer was single-acting Vulcan OR with rated energy of 30,225 ft-lb.

varying between 2.60 and 2.80 percent were obtained.

The extent of the initial development was determined after careful study of the many factors involved, such as traffic potential, leasing of special bulk-handling facilities, engineering problems, construction costs, potential operating revenues and expenditures, bond servicing, and other related matters. Features recommended for the initial construction and cargo handling equipment program, their estimated costs, and the total financial requirements covering the first stage of development, are shown in Table I.

When the revenue bonds required to finance the project had been successfully sold, detailed contract drawings and specifications were prepared. Priority was given to the grain handling terminal and to roads, railroads, and water supply. By July 1955, the grain elevator was in operation and handed over to the lessee, Cargill, Inc., of Minneapolis, Minn. By the middle of 1956, virtually all the remaining construction was either completed or nearing completion, with the exception of the transit shed, which was delayed by a shortage of steel. The shed has since been completed and is in continuous operation.

Actual construction and equipment costs have borne a notable similarity to the engineers' original estimates. This was the result of preparing a sufficient number of preliminary outline designs and of careful cost estimating in the report stage. In fact, because of the saving in bond interest, it was possible to add to the program an Administration Building for the Commission at a cost of $115,000. Port operations and traffic to date are in line with overall predictions and should be further stimulated by the rapid industrial and economic growth of the region now under way.

Waterfront problems

Engineering and design problems affecting the waterfront structures arose from both natural and man-made causes. Foundations had to be designed to suit the alluvial silts and clays of the area, deposited by the river over eons of time. Test borings to 120 ft below Mean Low Water indicated alluvial deposits without any well defined stratification. Density by blow count varied widely, as indicated in Fig. 1. Lenses of relatively high resistance are underlain by softer or less dense materials.

On the protecting levee, 20 ft high and 200 ft wide at the base, regulations prohibited the use of piling or other construction that would require penetration of the soil. Railroad tracks and highway connections to waterfront structures had to cross the top of the levee at right angles to its axis—or as nearly so as practicable.

Regulations also prohibited any impediment to river flow in the land area (batture) between the levee and the low-water channel of the river, which is subject to flooding during

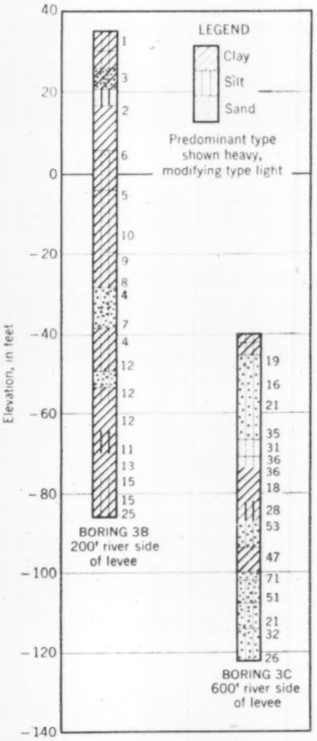


FIG. 1. Soil density varied widely along waterfront in vicinity of general cargo wharf, as shown by blow counts. Figures to right of borings indicate number of blows of 140-lb hammer dropped 30 in. required to drive 2-in. split-spoon sampler 1 ft after it had first been driven 6 in.

higher stages. Consequently filled embankments to carry railroad and highway connections to the waterfront structures could not be used. Instead, trestles were built on bents made up of steel-pipe friction piles of 24- and 33-in. diameter, and varying in length from 124 to 145 ft. The reinforced-concrete pile caps support 36-in. wide-flange steel girders, which carry the concrete decking. On the railroad connections, the trackwork is ballasted to simplify superelevation on curves.

Fluctuations in river stages, ranging from Mean Low Water (El. 2.50) to the maximum predicted flood of 46.50 ft above Mean Sea Level, required that the deck be at El. 52.5 for waterfront structures. With a Mean Low Water depth of roughly 35 ft along the wharf faces, this meant that the top of the deck was about 85 ft above the mud line.

Wharf structures were designed to withstand the horizontal forces due to ship impact in a lateral direction, as well as longitudinal forces due to water pressure on both ship and structure caused by the velocity of river currents which attain a speed of about 4 knots at higher stages. At the same time, it was important to provide a relatively open substructure to permit the passage of driftwood. To accomplish this aim, the general cargo wharf was designed so as to eliminate all lateral bracing in the substructure except for the north and south finger piers (extensions of the wharf apron), which presented a relatively small area to river flow. These factors, together with the functional deck loads, called for an unusually heavy type of construction, including a specially designed flexible fender system having a working face some 55 ft high.

TABLE I. Summary of capital requirements, first phase

	Facility	Estimated Cost
1.	General cargo wharf and finger piers, transit shed, interior offices, railroad and highway connections	$4,500,000
2.	Railroad tracks and yards	725,000
3.	Roadways and surface drainage	125,000
4.	Water supply and fire protection	200,000
5.	*Grain elevator, grain wharf, conveyors, railroad tracks and roadways, complete	3,100,000
6.	*Molasses tank farm and terminal, complete	500,000
7.	Cargo handling equipment	500,000
8.	Land acquisition and term notes	492,500
9.	Escrowed interest, 2½ years	1,093,750
10.	Professional fees—engineering legal, fiscal agents	716,250
11.	Working capital and contingencies	547,500
	Total	$12,500,000

*Facilities to be leased: grain elevator (2,800,000 bu) to Cargill, Inc.; molasses terminal (8,000,000 gal) to Industrial Molasses Corp.

General cargo wharf

The substructure of the general cargo wharf consists basically of pipe piles 24, 33 and 36 in. in diameter, and super H-piles made up of one 36 WF and two 30 WF steel beams welded together. The piles act as friction piles and vary in length between 130 and 160 ft. Bents are spaced 25 ft on centers, with piles spaced 20 ft apart. Decking consists of reinforced concrete slab supported on wide-flange steel floor beams and pile caps.

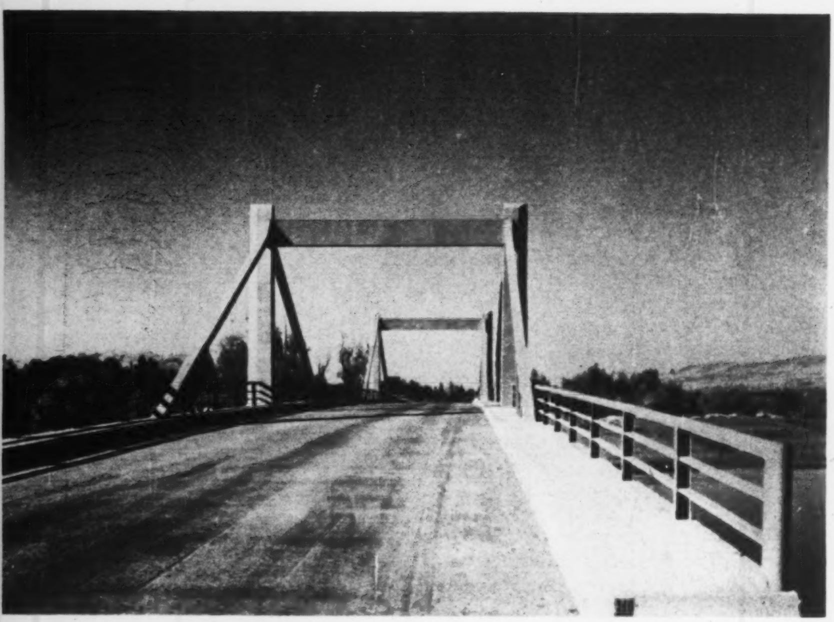
The fender system is a continuous, flexible type. It consists of vertical steel H-piles welded to horizontal steel H-wales, and faced with Greenheart timber wearing pieces. Rectangular rubber blocks, at three elevations, are used between the fender framing and the outer row of apron piles to provide the required flexibility.

The 40-ft-wide apron of the general cargo wharf carries twin railroad tracks and a traveling revolving portal crane of 30-ton capacity. Two catwalks with open-grating tread are provided below the apron deck along the full length of the wharf. Located at Els. +10.00 and +30.00, and immediately inside the outboard row of piles, these catwalks provide access to low-water mooring cleats. They are also used for inspection and maintenance.

The transit shed, 625 + 200 ft, has a single row of columns spaced 25 ft on centers down the middle. A clearance of 20 ft is provided under the roof trusses. There are steel roll-up doors at both ends and along the two sides of the shed. The land-side doors give access to a loading platform 12 ft wide, protected by an overhead canopy 18 ft wide. This loading platform is served by depressed twin railroad tracks along the full length of the shed.

Shed and wharf are serviced with the usual utilities, including a fire sprinkler system and outdoor floodlighting. Interior offices and facilities for U. S. Customs Service, and for operating and stevedoring personnel, complete an efficient and properly integrated general cargo waterfront terminal.

For the consulting engineers, Frank L. Lincoln, M. ASCE, of Fay, Spofford & Thorndike, and Jack S. Burk, of Barnard and Burk, served as partners-in-charge. The writer served as Project Engineer for the overall planning of the project. For the Greater Baton Rouge Port Commission, Earnest D. Wilson is President, and A. Stewart Wallace, Jr., Manager.



Benton City-Kiona Bridge spans Yakima River near Richland, Wash. Structure 400 ft long with 170-ft main span has deck depth of only 3 ft 3 in. to provide maximum waterway with minimum approach grades.

TIED-CANTILEVER BRIDGE—PIONEER

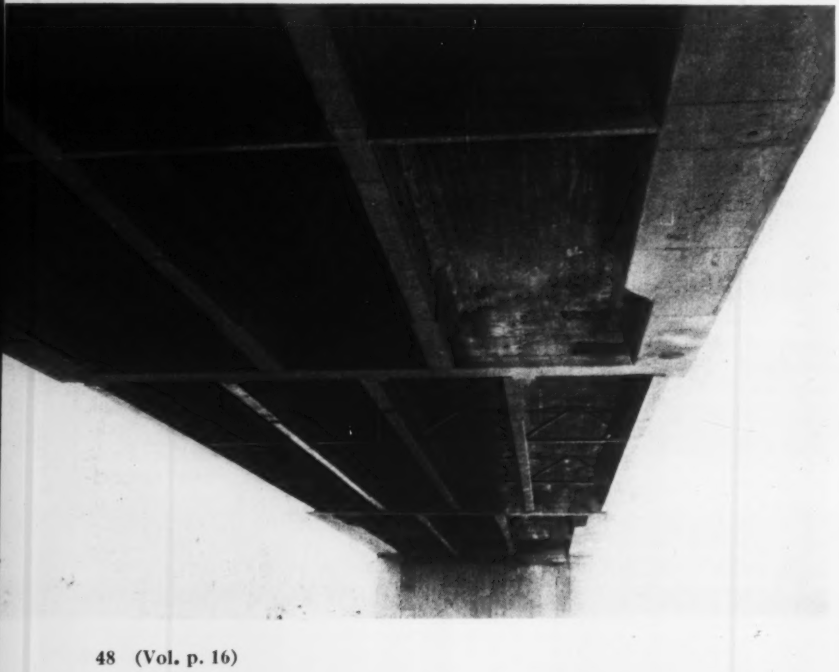
Replacement of the old bridge across the Yakima River at Benton City, about 10 miles west of Richland, Wash., presented a somewhat unusual problem. The established main Yakima Valley highway to which the bridge connects is only 150 ft from the south end of the bridge. At extreme flood levels, this highway has required sandbagging to avoid its inundation to a depth of a foot or more. The bridge, however, had to have maximum reasonable clearance above flood levels, since such levels mean drift of all sorts. Fair sight distances also had to be provided, as well as a cost that would appear fair to the bridge owner—Benton County, Washington.

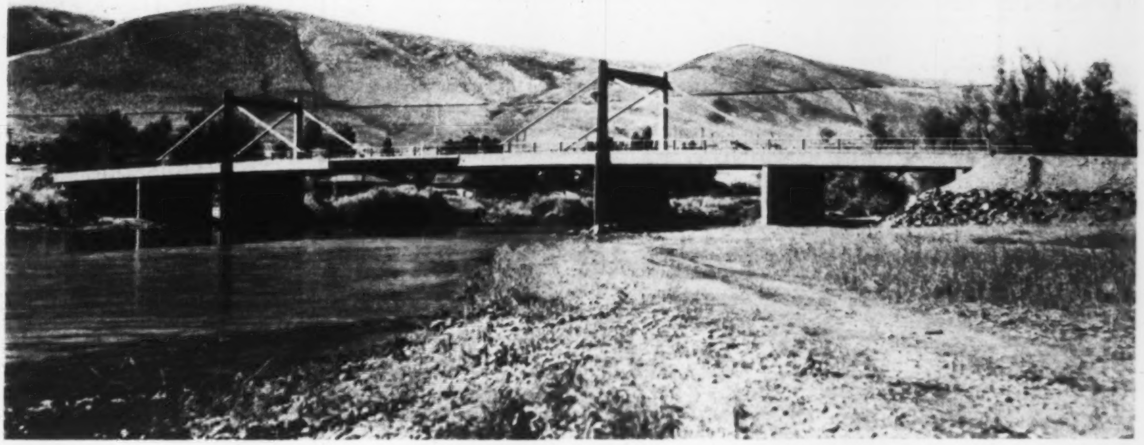
Study of these somewhat conflicting requirements led to the structure shown in the accompanying photographs. It has a 26-ft roadway, two 4-ft sidewalks, and is designed for H20 S16-44 AASHO loading. Its 170-ft main span—and the approach spans as well—have a deck thickness of 3 ft 3 in. For its full 400-ft length it is built on a vertical curve between 4-percent end tangents. At midspan it clears the maximum recorded flood level by 2 ft 9 in.

The bridge was placed under contract for $186,160. Certain changes during construction increased this cost to $192,240. Among these changes was the elimination of piles and the substitution of mass-concrete foundations. The discovery of cemented hardpan 6 to 8 ft below the river bed was the reason for this change.

Essentially the framing is like that employed in many three-span bridges—a suspended span supported on the cantilevered ends of the adjoining spans. This may be done with through

View of deck from below shows wide girder sections at sides (foreground), which are hollow to take the tied cantilever anchorage. Center "hung" section, of cover-plated wide-flange beam construction, is seen beyond. Form work was identical with that for inshore spans, except at ends of diagonals.





STRUCTURE IN U.S.

HOMER M. HADLEY, M. ASCE
Consulting Engineer, Seattle, Wash.

trusses on longer spans, as in the common cantilever-type bridge, or with continuous girders on shorter spans. Here funds were not available for through trusses nor was there depth available for full-span deck girders. Out of the exigencies of this situation arose the design which at the outset was called a "tied cantilever," and more recently, in the case of the great prestressed concrete bridge to be built at the entrance to Lake Maracaibo, Venezuela, a "balanced cantilever." Incidentally the present modest structure is approximately a model of the Venezuelan undertaking on a scale of 1:8.

Here a 60-ft central span of 33-in. wide-flange beams, composite with the concrete roadway slab, is supported on concrete beams of equal depth that span transversely across the roadway and terminate at the ends of the main diagonal ties. Concrete beams that are longitudinally continuous with those in the inshore spans find their outer support in these same transverse beams. The reactions of these beams are picked up by the diagonal tie members and delivered to the tops of the columns at the main piers. The balancing ties extend from the tops of the columns to the tops of the adjacent inshore piers.

These simple statements on picking up and delivering the loads cover practically all the special design features inherent in this type of structure. With H20 S16 loading and a slope of about 1 vertical on 2 horizontal for the diagonal tie members, these ties are each subjected to a stress of over 500 kips. How to pick up this load from concrete which, including sidewalks 10 in. above the roadway level, has an overall depth of only 4 ft 1 in., was initially a perplexing problem. Likewise the type and kind of diagonal to be used and the delivery of loads to the tops of the columns at the main piers were questions not immediately resolved.

It was desired that the type of construction adopted should be simple, readily installed, and in need of no field adjustments or strain gaging to determine relative stresses in two or more members. The diagonals should be trim and compact, and of course made of steel in some form. Also, the support and positioning of the diagonals at the time of erection dictated the prior construction of the concrete deck. An opening in the deck into which the lower end of the diagonal could be concreted seemed to offer the simplest type of connection.

What resulted was the use of 10-in. 112-lb wide-flange beams for the diagonals and columns, the latter being subsequently encased in concrete. The diagonals are set with their flanges vertical, thus matching the flanges of the columns, and each column has its two diagonals connected to it by plates curved in elevation and by high-tension bolts in single shear. Not entirely for architectural reasons, 1/4-in. plates were welded across the tops and bottoms of the diagonals and of the connecting plates. The enclosed spaces were filled with lightweight concrete. The 1/4-in. plates of the diagonals stop at sidewalk level.

How to adequately anchor the diagonals into the concrete of the deck was a matter of serious concern. As built, there are 2-in. double-extra strong pipe shear connectors, 6 in. on centers, welded between the flanges of the tie members on both sides of the web. Also there are angle connectors (2 1/2 × 1 1/2 × 3/8 in.) spaced 6 in. on centers, midway between the pipe connectors on the outer faces of the flanges.

This part of the anchorage was unquestionably satisfactory, but for some time the character of the hole into which the diagonal was to be inserted posed a troublesome problem. It must not have smooth surfaces; it must furnish adequate keying for the concrete fill; it must not restrict the placing of the diagonal. Finally came a completely satisfying answer—a length of 18-in. galvanized corrugated metal pipe permanently embedded in the concrete and extending entirely through it, the pipe ends being cut flush with the concrete, top and bottom. Not only does the corrugated surface of the pipe afford a mechanical interlock with the fill concrete, but chemical interaction between the galvanizing coating and the cement paste further improves the bond.

The pipe is embedded in the solid section of concrete, 3 ft wide, in which the marginal box beams, 4 ft wide, terminate. To assure the integrity of this outer solid mass, a 24-in. round spiral of No. 5 bar, 6-in. pitch, surrounds the pipe, while closed stirrups or binders of No. 5 bar, 6 in. on centers, constitute peripheral reinforcement. The transverse beam is thoroughly anchored into the end of this solid terminal section, and the horizontal plate of the roadway slab connects with both beam and terminal section. Conventional shear keys were purposely omitted from all construction joints; instead the lower surfaces were scored and roughened. As again shown by the recent tests of W. E. Dean, M. ASCE, Assistant State Highway Engineer of the Florida Highway Department, normal concrete surfaces in conjunction with upstanding stirrup ends are quite adequate in themselves to prevent slippage from horizontal shear. Why make keys with smooth surfaces when it is possible to provide surfaces 100 percent rough?

Connection of diagonals to deck, when finally made, was by means of 4,500-psi concrete fed into the corrugated pipe and tamped and vibrated into position. Every effort was made by the resident engineer and the contractor to obtain full placement. That their efforts met with a reasonable degree of success the following occurrence shows.

The specifications contained this paragraph:

"Because of the need for shallow depth of deck, falsework piling bents, spaced not over 15 ft on centers longitudinally, shall be provided and installed beneath each steel or composite beam in the central part of the main 170-ft span. Each beam shall be wedged tightly against this falsework to prevent any settlement when the loads of the roadway slab and forms are imposed upon them."

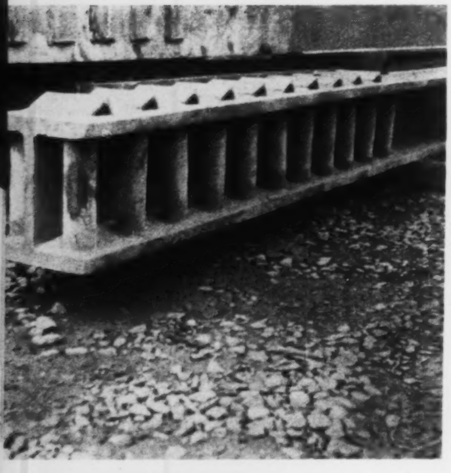
In the specified construction procedure, the installation of the steel beams in the middle of the 170-ft span and the concreting of that part of the deck was to constitute the last major operation and was to follow the completion of all other parts of the bridge. Steel beams having come early to the job, the contractor asked permission to install them before the adjoining concrete sections were poured, and when he assumed full responsibility, permission to do so was granted. By this means the contractor assured himself freedom from trouble in adjusting the beams to their connections with the transverse concrete beams. As soon as the main diagonal ties had been fully installed, he sought permission to pour this remaining unfinished section of roadway slab. Again, when he assumed full responsibility for the security and safety of everything, he was permitted to proceed.

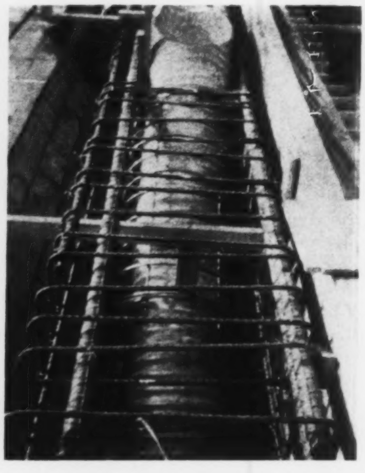
Six days after he had completed this last roadway pour, the river started to rise and drift started to accumulate against the falsework. On the seventh day, rise and drift both continuing, the falsework for the full 170-ft span collapsed progressively and disappeared down river, starting at the north bank and proceeding to the south. Thereupon the diagonal tie members received their full design quantities of dead load—and gave not the slightest indication of inability to receive and transmit them. Undoubtedly they are well anchored, each in its corrugated metal pipe. The bridge was opened to traffic July 4, 1957.

This type of bridge has proved very satisfactory here. Louis Balog, M. ASCE, recently reported on three European bridges of the same sort. So far as the writer knows, this Benton City-Kiona Bridge is the first of its kind in the United States. This type of structure, with steel box girders, appears to be admirably adapted to spans of 400 to 600 ft—depending of course on local conditions and required clearances.

Essentially the designer of such a bridge cuts his main span into thirds and deals with flexure in that span length instead of in the full span length. The price paid for this gain is the cost of columns, diagonals, and their anchorages. These are all essentially simple elements and, being straight, they yield only axial deformations. Stiffness of structure consequently follows. Such a bridge appears to have definite advantages and no serious disadvantages and therefore merits much greater use than it has so far enjoyed.

Construction of this bridge was supervised by Dale Bean, J.M. ASCE, Benton County Road Engineer, and his staff.





Anchorage elements for end of steel diagonal (far left) slide into corrugated pipe of 18-in. diameter (left). Concrete is placed around the pipe as deck is cast. Later the heavy beam is concreted into the pipe.

Sweden excavates 2,100,000 cu yd for tailrace tunnel of underground power plant

TORE NILSSON, M. ASCE, Civil Engineering Director, Swedish State Power Board, Stockholm, Sweden

Half the water power in Sweden is generated in underground stations, and of the 2.6 million kw to be installed by 1963, three-fourths is underground. Starting in 1910, some 26 plants with a capacity of more than 10,000 kw each have been built underground in Sweden, and 18 of more than 10,000 kw each are now under construction. Nine of these, with capacities of over 100,000 kw each, are listed in an accompanying table.

The foregoing facts are taken from the author's paper, "Underground Power Plants in Sweden," presented at the ASCE Annual Convention in New York, at a joint session of the Power and Construction Divisions. This paper was included in the four-session symposium on underground power plants arranged by R. A. Sotherland of Ebasco Services Inc., for the Power Division. This and other papers in the symposium are under review for inclusion in the Journal of the Power Division. The article here presented is based on Appendix 1 of Mr. Nilsson's longer paper.

VITAL STATISTICS

Labor hours, per cu yd:	
Top heading	0.56 hour
Benches	0.25 hour
Average for whole tunnel	0.37 hour
Consumption of explosives, per cu yd:	
Top heading	1.33 lb
Benches	0.97 lb
Average for whole tunnel	1.08 lb
Actual cost and/or estimated cost, per cu yd:	
Top heading	$4.06
Benches	2.61
Average for whole tunnel	3.19

All costs, even administration, are included.

All labor is paid on a piece-work basis.

The average wage has been $1.46 (7.50 Swedish Crowns) per hour.

Special equipment is required for final inspection and scaling because of 87-ft height of tailrace tunnel for Stornorrfors underground power plant.

Three-deck jumbos with lightweight rock drills were used on top heading (top view). Jack legs permit jumbos to be lowered onto same trucks that haul rock, for moving in and out. Jumbos for benches (lower view) drill holes downward inclined 2 on 1 for full width of bench.

Larger underground hydro plants under construction in Sweden

Plant	Capacity, 1,000 kw	Head ft	Year in Operation	Owner
Stornorrfors	375*	244	1958	State
Messaure	240	282	1963	State
Trangslet	240	466	1959	Private
Ramsele	150	259	1958	Private
Kvistforsen	130	164	1960	Private
Holjes	110	289	1962	Private
Sallsjo	106	635	1962	Private
Balforsen	105	102	1958	Private
Stalon	100	653	1961	State

*500,000 kw ultimate

NOTE: Also under construction by the Swedish State Power Board is an underground steam-power station with a rated capacity of 480,000 kw.

Advanced techniques for tunnel driving developed in Sweden have made possible the construction of very large tunnels. The 500,000-kw hydroelectric power plant Stornorrfors in north Sweden, scheduled for operation by 1958, will have a tailrace tunnel that possibly will be the largest power tunnel in the world. This very large power plant is underground in good rock (granite and gneiss). The tailrace tunnel will have a length of 2.5 miles and will require 2,100,000 cu yd of excavation. It is designed for a flow of 28,000 cfs and has a cross section of 4,200 sq ft with a top-heading width of 53 ft and a height of 87 ft. See Fig. 1. Of the long power tunnels previously excavated in Sweden, the largest has a cross section of 2,250 sq ft. The tailrace at Stornorrfors therefore represents considerable progress in this type of excavation.

If two smaller tunnels had been constructed instead of the single large one, their total cross-section area would have had to be about 18 percent larger than that of the single tunnel to operate at the same loss of head.

Experience from previously constructed power tunnels indicates that no arrangements need be made for maintenance of large tunnels if they are excavated in good rock. The need for two tunnels to provide for future inspection was therefore eliminated.

Experience based on the construction of earlier underground chambers indicated that it would be possible to excavate a tunnel of the size required. Exploration indicated the presence of good rock but there was no guarantee that such a large tunnel could be safely excavated within reasonable limits of reinforcement and risk. Considering the great possible savings—the difference in cost would be about 25 percent—it was decided to start the construction work by excavating the upper part of the tunnel (with a 1,730-sq ft cross section) and then enlarge it by excavating in the first step a bench about 26 ft high. If this could be successfully carried out, another bench 24.5 ft high would be excavated. With such a sequence it would be possible to gain the necessary experience as the work progressed. If difficulties encountered should prove too great, the large tunnel could be divided into two smaller branches. In such a way the single large tunnel would not prove too hazardous—as many feared it would turn out to be.

The work has now (December 1957) reached the stage where the top heading and the first bench are completed. The second bench has been excavated for 75 percent of the length of the tunnel, and it is now evident that the

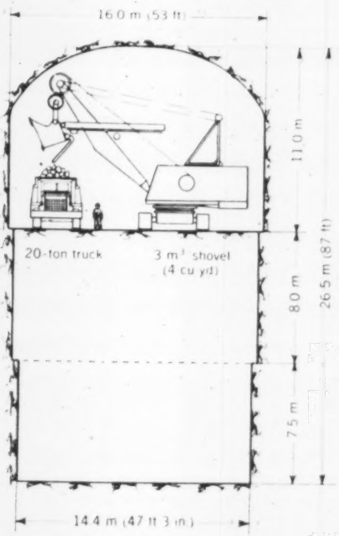
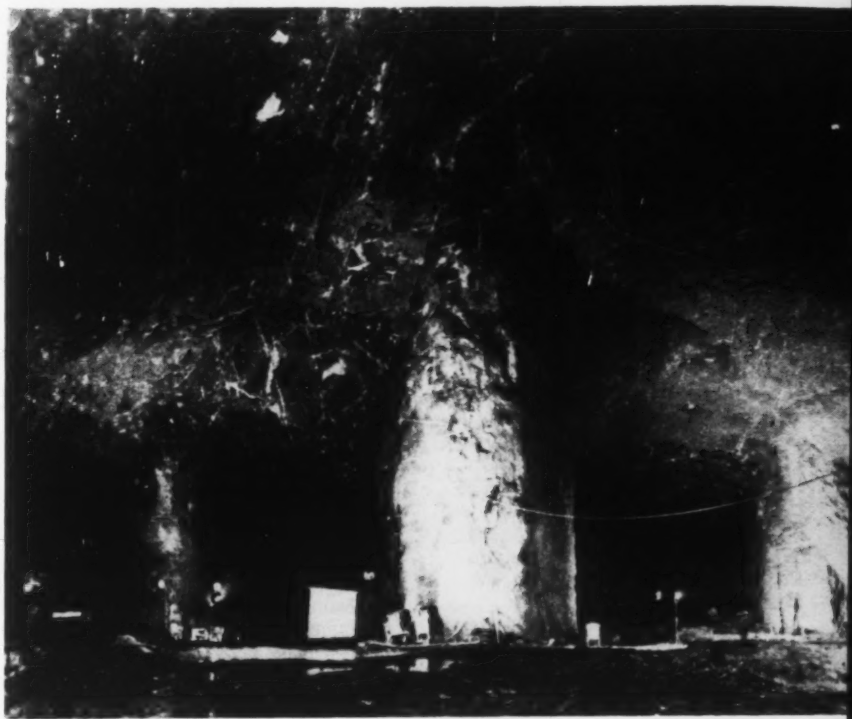


FIG. 1. Stornorrfors tailrace tunnel is being excavated in three sections—top heading with cross-sectional area of 1,730 sq ft; first bench of 1,300 sq ft; and second bench of about 1,160 sq ft.



Smooth rock faces obtained are seen in view of Stornorrfors draft tubes.

single large tunnel project can be successfully carried out. The tunnel has been attacked from both ends and from an adit about midway of its length.

Drilling for excavation of the 1,730-sq ft top heading was done with lightweight rock drills and jack legs from two three-deck jumbos, each covering half the tunnel face. The jumbos were moved in and out by the trucks that hauled the rock. To facilitate these operations, each jumbo was equipped with hydraulic jacks that lowered it to the truck body for movement back from the face. Mucking for the top heading and benches is done with 4-cu yd electric shovels loading trucks of 22-ton capacity. Excavation is done in three 7.5-hour shifts. The cycle per round consists of one shift drilling and blasting followed by two shifts mucking and hauling. The operations are strictly timed. For the bench excavation, holes are drilled downwards with an inclination of 2 on 1 from a traveling platform covering the width of the bench. On the drilling platform 13 rock drills, each with a chain feeder, are erected.

Because of the danger of hitting undetonated explosives remaining from the excavation of the roof gallery, drilling through the top layer of the bench is remote-controlled. When the drills have been set, the drillers move back of a barricade so that they are protected against blasting hazards when the drills are started.

Drilling mechanized

The drilling operation is mechanized to such extent that each driller operates three rock drills. The labor cost for the drilling is therefore comparatively low and even less than the cost of drill steel. Millisecond-delay blasting caps are used. Drilling and blasting operations proceed simultaneously with mucking and hauling, each operation being independent of the other. The same mucking shovels are used for the benches as for the top heading. Excavation of benches is performed on two 7.5-hour shifts per 24 hours.

During the last stages of the work, the height from the bottom of the tunnel to the roof will require special equipment for safe inspection and scaling of roof and walls. For this work it is planned to use a platform that can be moved and operated by the scalers while they are on it.

The tunnel will be unlined except in a few spots where the quality of the rock requires concrete reinforcement. In certain areas rock bolting is used, and the bolts are grouted. Prestressed bolts are normally not required.

Excavation of the approach tunnels started in February 1954, and that for the top heading in February 1955. The top heading was completed in May 1956, and the whole tunnel is scheduled for completion in March 1958.

Average advance in the top heading was 22 ft per round, and the normal monthly performance was 400 ft on each face. A more rapid rate of advance has certainly been achieved in tunnels of smaller size, but in no tunneling work has a larger volume been taken out in continuous operations. In each round, that is, every 24 hours, 1,500 cu yd of solid rock, or about 2,300 cu yd of loose rock, has been removed from each face. In bench excavation, the advance is 50 ft per day, in two shifts, which represents a volume of 2,400 cu yd of solid rock per day at each face.

Total cost of the tunnel excavation, including administration and overhead, is $3.19 per cu yd of solid rock. The average wage to date (all on a piecework basis) is $1.46 per hour. The work is being done by the Swedish State Power Board through its Civil Engineering Department.

J. D. NAILLON, A.M. ASCE, Chief Engineer, Herrick Iron Works, Hayward, Calif.

Steel fabricator builds his own plant

Design, construction, and cost details for a West Coast fabricating plant

Keeping pace with California's expanding needs, the 36-year-old Herrick Iron Works has just constructed a completely new, unusual, and low-cost steel fabricating plant. Located on a 34-acre site at Hayward, Calif., the new facility was designed with a self-supporting light-gage steel roof to meet these important criteria:

1. For a fabricating plant, the structural steel work must be exemplary.
2. Financing required that the cost of construction should not exceed a limited sum. The design therefore had to be such that substantial parts could be deleted or added for budget control.
3. Construction economies were essential to get the most plant for a minimum expenditure. Economy could be attained through simplicity of design, utilizing duplication to the limit.
4. Future expansion must be possible with a minimum of disturbance.
5. The building should be spacious and uncongested.
6. Materials must move in an orderly pattern with a minimum of reversing or cross flow.

Based on the last requirement, the plant layout shown in Fig. 1 was established. Design and construction of the new facility were handled by a management team consisting of Stephen G. Herrick, President; H. W. Dornsife, General Manager; Ernest Richards, Production Manager; W. C. Rowley, Project Engineer; with the writer as Chief Engineer. To fulfill the design requirements set forth by this team, a functional approach was required. The function of the building is to:

1. Support bridge cranes.
2. Provide weather protection for personnel and equipment.
3. Support and house utilities.

Function No. 1 could be provided by a self-supporting craneway without a roof; functions Nos. 2 and 3 could be provided by modifying an A-frame craneway to support a roof.

The warehouse and shipping areas of a steel fabricating plant can, if the owner wishes, remain uncovered—particularly in temperate climates. The modified craneway, then, with some parts covered and some uncovered, as desired, is adaptable to a steel fabricating plant. Likewise the design requirement of close budget control could be partly achieved by adding or deleting parts of the roof. Exterior walls are another item that can be added or omitted to effect control of expenditures. Leeward walls could, if desired, be omitted.

An article in a technical journal concerning the Phoenix, Ariz., Coliseum indicated that an arch roof of components manufactured by the Wonder Building Corporation should be investigated as a possible roof for the craneway. The writer visited the Phoenix Coliseum and the factory in Chicago where the sections were manufactured. The arch units appeared to be functional and economical. Each arch would cover 2 lin ft of building. Varying coverage thus would allow close budget control.

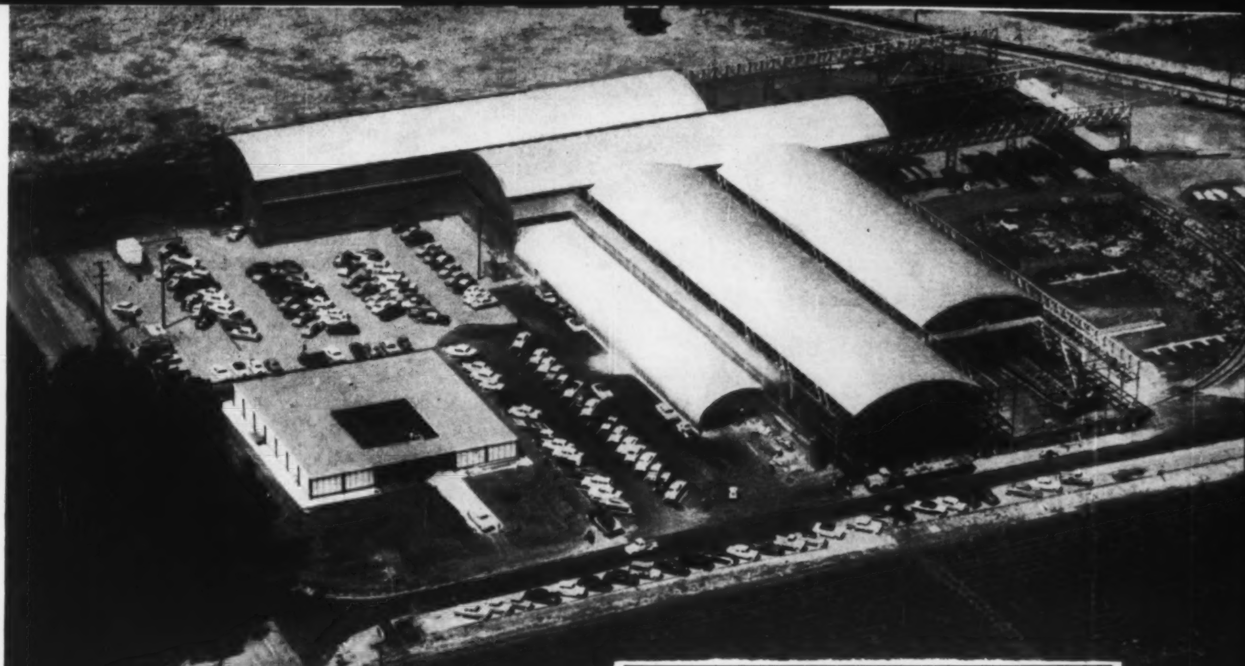
Adapting the Wonder Building Corporation's "Truss-Skin" roof to cover a craneway required special designs for connecting the arch to the structure, for disposing of runoff, and for neutralizing the effect of the horizontal component of the arch thrust. When preliminary designs for these special details showed that the structure was feasible, a light-gage steel arch was selected as the roof for the plant.

Soil in the area generally consists of layers of hard clay and sandy clay to a depth of 30 ft, where sand and gravel are encountered. A soil investigation by Woodward, Clyde and Associates resulted in a recommendation for spread footings with a maximum allowable soil bearing value for combined loadings of 3,000 psf.

Before the foundation was constructed, the entire site was leveled and compacted to 90 percent of the density attainable in the laboratory. The compacted clay, when excavated by a trenching machine, presented a smooth finished surface. The I-shaped footings (Fig. 2) were designed to accommodate mechanical excavating equipment. Specifications were written to permit the contractor to place concrete in the footings without forms, by cutting the trench to a neat surface. Forms were used only for two footings in sandy areas and for the short columns extending above the floor level.

The main structural frame to carry the crane and roof loads consists of repetitive basic units employed throughout the buildings. The box trusses (Fig. 2) are of three basic types. Type A trusses consist of two side trusses designed for crane loadings and a bottom, horizontal truss to transmit lateral forces to the towers. Type B trusses consist of an outside "wall" truss, a "crane" truss, and a bottom truss. Type C is a modified Type A that can be converted to a crane truss, thus giving initial economy while providing for future expansion. For maximum duplication, all bottom trusses are identical, all crane trusses are identical, and all wall trusses are identical.

The span-to-depth ratio and the span-to-width ratio of the box trusses is about 4.5 to 1 to insure a comparatively rigid structure with a minimum deflection. The box trusses are 8 ft 11 in. wide from center to center of columns and 9 ft deep from center to center of chords. The top chord of each crane truss is tilted at an angle of 31 deg 45 min from the vertical to align with the arch-roof radial line at that point. The top chord consists of a 10 WF 22.9 and a 7-in. 9.8 channel, designed to carry the interactions of bending due to arch thrust and compression due to truss action. The top chord—in fact all the structural steel—was selected on the basis of imme-



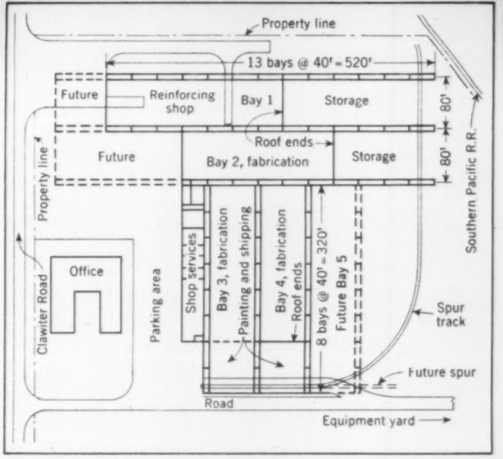


FIG. 1. New fabricating plant of Herrick Iron Works can be expanded as business warrants. Work just completed was detailed to allow variation in amount of structure enclosed, to permit close budgetary control.

diate availability rather than design efficiency alone. Wide-flange shapes, from eastern mills, were in very short supply when the structure was designed and were used for only 15 percent of the total tonnage.

The towers are of two types—those designed to support end reactions from Type A box trusses (crane load on both sides) and those designed to support end reactions from Type B box trusses. Towers for Type C box trusses were made the same as towers for Type A trusses.

Fabricating the structural steel presented a problem. The existing Herrick shop was not well suited to the job, and the work would be disruptive to other jobs going through at the time. Duplication of fabricated parts made a solution possible. An empty bay was rented from another local fabricator and, with a minimum of moved equipment, the steel for the new plant was fabricated.

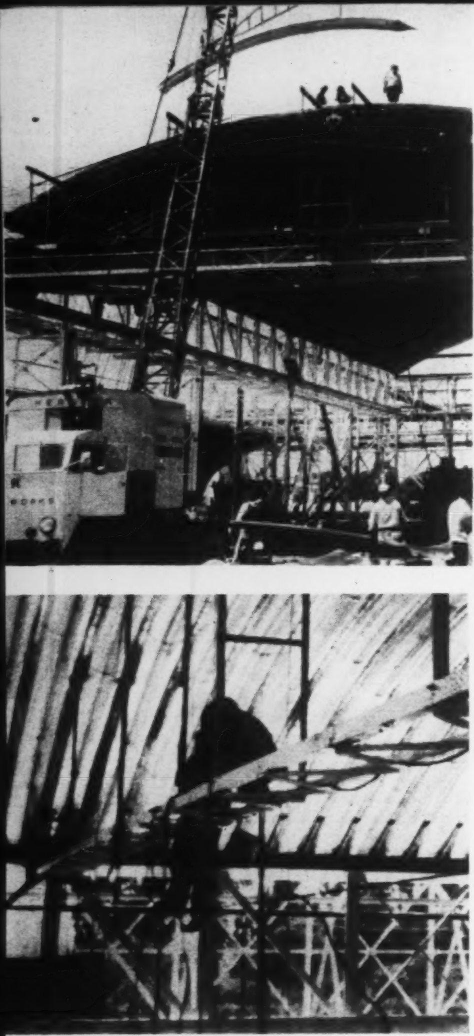
Each 40-ft-long box truss, weighing about 10 tons, was assembled in a jig and welded. Jigs were used for the towers also. Plate clips (Fig. 3*b*) were shop welded on 2-ft centers along the top chord of the crane trusses to receive the arch roof. These were located to a tolerance of 1/8 in. longitudinally. (Experience in erecting the roof proved that a tolerance of 1/4 in. would have been acceptable.)

One coat of red lead primer TT-P-86a, Type I, was applied to all structural steel. Steel not exposed to the weather was given one finish coat of aluminum, and steel exposed to the weather was given two finish coats of aluminum.

Wonder Building Corporation's 18-gage Truss-Skin roof sheets have a nominal width of 2 ft and a depth from crown to valley of 7⅞ in., as shown in Fig. 3 (*a*). The sheets conform to ASTM designation A-245-52T, galvanized with 1¼ oz of zinc per ft to meet the requirements of ASTM designation A-93-55T. The manufacturer has developed a machine that places transverse corrugations in the sheet. The crimping action of these corrugations causes the sheet to curve longitudinally. The radius of curvature is controlled by the depth of the transverse corrugations. The length of a standard sheet is about 10 ft with holes for 5/16-in. bolts 12½ in. on centers along each rib, plus six additional holes across each end. Watertightness is achieved by lapping the sheets, by using neoprene washers on the bolts, and by placing mastic at the laps. The roof derives its strength from the combined action of several arches bolted to form a monolithic structure.

The Herrick Iron Works roof consists of an arch of eight standard sheets spanning 71 ft between abutments. The Pacific Coast Uniform Building Code requires that roofs of this type be designed to carry a live load of 12 psf over the entire span, or a half-span load of 6 psf. Including the dead load of 3 psf, these loads produce maximum stresses of 2,600 psi and 4,300 psi respectively. These low stresses allow sufficient margin for buckling and stress amplification of a flexible arch.

Several designs were studied for attaching the arch to the top chord of the box truss. The bent pipe, Fig. 3 (*b*), was selected for ease of fabrication and erection. Four Nelson studs were welded to each pipe bracket, 12½ in. on centers to match the holes in



Truck crane hoists an arch subassembly to workmen on roof. Rolling scaffold was built by placing timbers and scaffold on a bridge crane. Note temporary cable tie (lower photo) supported from roof by hangers. Need for this was shown during erection, when towers deflected, causing crane wheels to bind. Tie prevented further trouble.

the arch rib. The holes in the arch were reamed to fit the ½-in. studs. The pipe bracket was attached to the top chord of the truss by two welded plate clips through which a ¾-in. bolt was inserted. Thus the entire roof acts as a two-hinged arch. Longitudinal bracing is achieved by making a portal frame of two adjacent pipe brackets at each tower.

The horizontal component of the arch thrust is transferred to the floor trusses through X-bracing (Fig. 2). Arch ties, connected at the top of each tower, prevent spreading of the towers as a result of the thrust. The ties (actually struts) are shown in a photograph. They are designed to act in compression as well as tension to keep the craneway in alignment and to distribute the wind loads to adjacent towers. Each tie is composed of two angles 4 x 3 x 5/16, with angle lacing bars in the horizontal plane. The ties are supported at about 14-ft intervals by hangers attached to the arch rib by a clip angle. The clip angle is bolted to the arch rib by three ½-in. bolts, 12½ in. on centers, substituted for the regular 5/16-in. bolts.

Lateral deflection of a flexible steel arch causes an amplification of stresses not found in a rigid arch. (See Miklofsky & Sotillo, "Design of Flexible Steel Arches by Interaction Diagrams," Journal of the Structural Division, ASCE, Vol. 83, No. ST2, March 1957.) Two pairs of cross bracing rods, Fig. 2, were installed at the center of the arch tie to reduce lateral deflections.

To carry rainfall from the arch roof required a special design. At the spring line of the arch, the valley of an arch sheet is lower than the top chord of the box truss, thus forming a pocket. A transition sheet, one-sixth of a standard sheet in length, was designed to eliminate the pocket. The transition sheet results from the intersection of a plane with the typical section. See Fig. 3 and accompanying photos. Galvanized corrugated sheets, Fig. 3 (*b*), carry the water to a valley at the center of each truss, whence downspouts conduct it to underground drains.

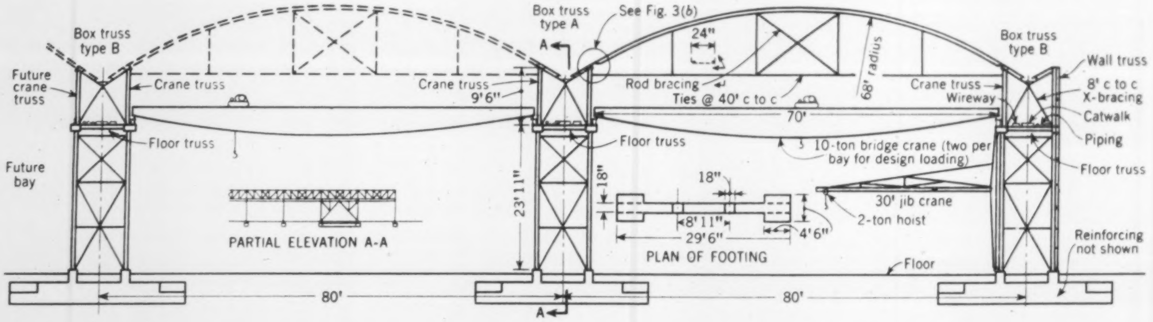
The erection scheme for placing the 1,080 lin ft of arch roof and installing the 85,000 bolts of 5/16-in. diameter required to form the roof was given extensive study. Scaffolding is required to hold the roof in place until it is bolted. Rolling scaffolds, supported on the floor, were not selected for two reasons: (1) the floor paving was not then installed, and (2) excessive height from the floor to the crown of the arch, 46 ft, would require too much scaffolding to be economical.

Roof erection

A form of rolling scaffold had to be devised, and the self-supporting feature of the craneway structure was put to good use. Delivery and erection of the bridge cranes were scheduled to precede the roof erection. Timbers were placed on the transverse rails of the bridge and 2-in. plank secured to the timbers. From this platform, scaffolding was placed to support the roof sheets. The crane rails provided a smooth and level surface from which to erect the arch. Dimensional control of the 68-ft-radius arch was obtained by measuring vertical offsets from the top of the transverse rail on the bridge crane. Arch ties, and hangers for the ties, were erected from a working space on the "aft" end of the platform. The scaffold supported five complete arches and was rolled forward when the five arches (10 ft of roof) were erected and bolted.

One complete arch, 2 ft wide, consists of 7⅔ standard sheets, plus 2 transition sheets. Each arch was subassembled in three pieces on the ground as follows: (1) one subassembly consisting of 1 transition sheet and 2 standard sheets; (2) one subassembly consisting of 3 standard sheets; (3) one subassembly consisting of 2⅔ standard sheets and 1 transition sheet. Gun-type mastic was applied adjacent to the holes along the top of the rib

FIG. 2. Typical section through fabricating bays shows location of three types of trusses, plus partial elevation of Type A truss and typical footing plan.



which was to lap over the previously erected arch.

As each subassembly was completed, a truck crane using a spreader bar, hoisted the subassembly to the roof and the crew on the scaffold bolted the sheets in place. The pipe brackets (Fig. 3*b*) were hoisted to the platform and bolted into place four or five at a time, ahead of the arch construction. The reamed holes in the end sheets of each arch were placed over the Nelson studs of the pipe brackets, thus securing the arch to the box truss.

At the beginning the erection crew consisted of nine men—five on the ground and four on the roof. The ground crew consisted of one rigger, one mastic applicator, two men bolting sheets together, and one man reaming for the pipe brackets and bolting. With this crew, the production rate was 26 to 36 lin ft of 71-ft-wide roof per day. Since five men on the ground could not keep the four men on the roof busy, after some adjustment the crew was changed to 12 men, seven on the ground and five on the roof. The 12-man crew erected 50 to 64 lin ft of roof per day. Thus production was almost doubled by a one-third increase in the crew.

The Shop Services Building, Fig. 1, is an open-side U-5 Wonder Building. This type of building was easy to attach to the craneway structure and presents an appearance in keeping with the rest of the structure.

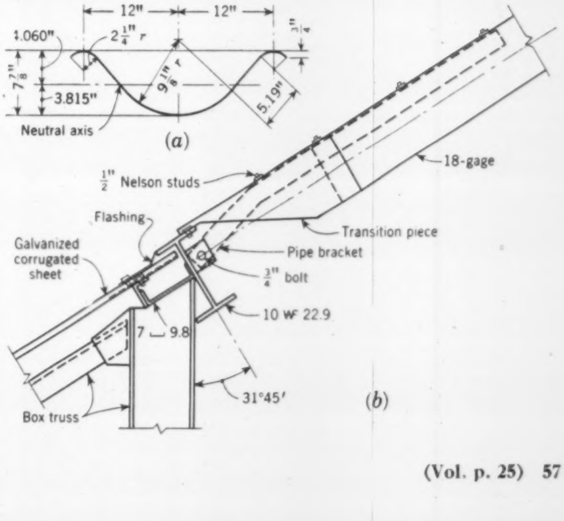
Exterior walls are of 24-gage galvanized corrugated iron. Walls generally are only on the windward side of the building. The wind and storm pattern, based on local airport data, indicates that an infrequent storm may come from almost any direction. Experience may require the addition of walls on other, or all, sides.

The main building structure, including crane rails and wall framing, but excluding arch ties and pipe brackets, required about 580 tons of structural steel. On today's market this costs about $340 per ton erected. Based on 133,370 sq ft of main building area, the building contains 8.7 lb of steel per sq ft of floor area. Thus the structural steel cost $1.48 per sq ft of floor area.

The arch roof covers 76,680 sq ft. The cost erected—including transition pieces, ties, pipe brackets and Wonder Building Corp. sheets—was about $98,000, a unit cost of about $1.28 per sq ft of arch roof area. This unit cost was for an 18-gage sheet with a 12½-in. bolt spacing along the arch rib. The unit cost for a roof using a different gage sheet or a different bolt spacing would vary accordingly.

Arch sheets are subassembled before erection (top). At same time, end pieces are added, which allow water to run off roof. In photo at right, workman bolts bracket to arch just erected. Arches are attached to top chord of box truss by pipe brackets connected to plate clips. In photo below, note special pieces for drainage in place at ends of corrugated arch sections.

FIG. 3. Sections for roof, detailed in (a), were developed from 18-gage galvanized sheets and were connected to columns and trusses as shown in (b).



Site of an ancient canal can still be clearly seen running along edge of alluvial valley of the Tigris near city of Mosul, on opposite bank from Nineveh. According to tradition, Nimrod may have built this canal, seen here in air view taken by the author.

DAMS — their effect on

Ancient river civilizations such as existed in the historic valleys of the Nile, Tigris and Euphrates were famous for their canals and irrigation works which, then as now, depended primarily on dams as key control structures. However the importance of other ancient irrigation devices such as the *shadoof*, the *sagia*, the Archimedean screw, and the water wheel should not be underrated.

Because of the influence of dams on the very existence of many ancient peoples, it may be of interest to review information on this subject gleaned by the writer from numerous publications, supplemented in some cases by a personal visit to the area under discussion.

Sadd el-Kafara Dam

The remains of what is referred to as the oldest dam in the world, the Sadd el-Kafara, were discovered in 1885 by Schweinfurth[1] in the Wadi el-Garawi about 18 miles south of Cairo, Egypt. See Fig. 1. The well-preserved abutments of the dam can still be seen and, according to Murray[2], its age is not in dispute. On the basis of the style of its masonry and the nature of the potsherds lying in the workmen's huts about 200 yards from the site, Schweinfurth[1], Mackay[3], and Murray[2] all agree that it was erected during the IIIrd or IVth Dynasties, between 2950 and 2750 B.C., or about 4,800 years ago.

Detailed measurements made by Murray indicate that the structure was 348 ft long at the top and 265 ft long at the base, and had a crest height of about 40 ft above the stream bed. The structure was made up of two separate rubble masonry dams, each around 80 ft thick at the base, with a space of 120 ft along the stream bed between them. This space was filled with random material from the stream bed and adjacent hillsides. The upstream and downstream dams contained about 30,000 cu yd of dry rubble masonry consisting of roughly dressed limestone blocks weighing about 50 lb each, which were laid up in steps about one foot high on a slope of 3 vertical on 4 horizontal.

Schweinfurth, the discoverer of the dam, was of the opinion that it had been constructed to provide drinking water for the workmen at an alabaster quarry located about two miles to the east of it. The capacity of the reservoir was only about 460 acre-ft, and the drainage area above the dam 72 sq miles.

Although the Nile valley is subject to storms of cloudburst type that produce damaging floods in the small tributary wadis, no spillway was provided for this dam. The evidence indicates that the dam was overtopped, and failed, soon after it was completed as there is no sign of any sediment deposits in the reservoir area. Apparently the failure of the dam so impressed Egyptian engineers that no dams, at least of masonry, were built for several thousand years thereafter. One wonders how different might have been the history of Egyptian irrigation if the designer of this structure had provided a spillway and a cutoff wall, and had made use of mortar between the carefully laid rubble masonry blocks. The ancient Egyptians had knowledge of mortar but did not use it as a cementing material.

Lake Moeris control dams

All Egyptian efforts to control water did not end as disastrously as the building of the ancient Sadd el-Kafara Dam. About 2300 B.C. they diverted the flood flows of the Nile into historic Lake Moeris, a depression having an area of 656 sq miles and a capacity of 40 million acre-ft. The lowest point in the depression is 150 ft below sea level. This depression, located 50 miles southwest of Cairo and now known as the Province of Fayoum, contains over 360,000 acres of rich irrigated land.

When the Nile was dangerously high, ancient Egyptian engineers led the flood flows through a canal into this depression. They also provided for the return of the stored water to the river when the inundation had come to an end so that storage capacity would be available when the next high water came. The flow was controlled by two earthen dams[4] which were cut through only in times of emergency and were reconstructed again at an expense in labor that even the pyramid builders considered excessive. By cutting the dams in a year of ordinary or low flows, the level of the Nile in Lower Egypt could be lowered to such an

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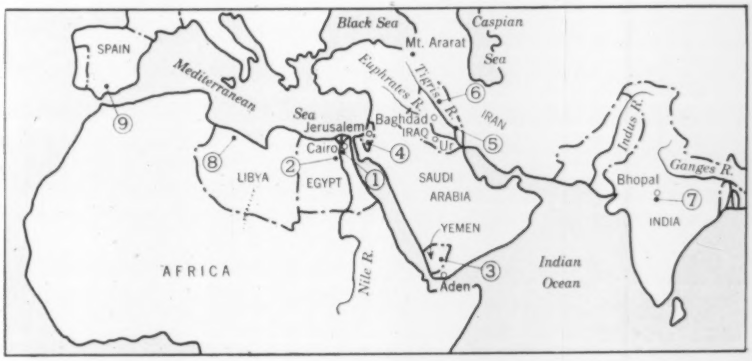


FIG. 1. Some ancient dams and other irrigation works are spotted on map:
(1) Sadd el-Kafara, circa 2850 B.C.
(2) Lake Moeris, circa 2300 B.C.
(3) Marib Dam, circa 750 B.C.
(4) Negev dams, 200 B.C. to 700 A.D.
(5) Nahrwan Canal, circa 2100 B.C.
(6) Atheim Dam, ancient times
(7) Bhojpur Lake, circa 1100 A.D.
(8) Tripolitanian wadi dams, Roman times
(9) Moorish and Spanish dams, circa 1500 A.D.

some ancient civilizations

extent that a famine would inevitably result.

There are records of four famines of long duration in Egypt. One is the famine of Joseph's time, about 1730 B.C., described for us in the closing chapters of the Book of Genesis. In Joseph's time there were two kingdoms in Egypt, the Hyksos of Lower Egypt and the Egyptians of Upper Egypt. The frontier fortresses of Lower Egypt lay where the Upper and Lower Egypt of that day met, that is, at the head of the Lake Moeris Canal. It was the capture of Lower Egypt's frontier fortress and the breaching of the dams controlling the flow into Lake Moeris by the King of Upper Egypt that produced Joseph's famines. Only recapture of the fortress and repair of the dams brought the famines to an end.

Egyptian engineers of that era were extremely talented. Not only did they build the rock-filled Sadd el-Kafara Dam and the large earth-dam regulators for Lake Moeris, but they were the first to work in natural stone. About 2940 B.C. they erected the first step pyramid, that of Sakkarah, the oldest surviving building of stone masonry. They also built a canal so that shipping could go up the Nile around the first cataract, and constructed a canal 100 miles long connecting the Mediterranean and the Red Sea. In the time of Darius the Great this canal was 200 ft wide and 40 ft deep. History records that it was in use for over a thousand years.

The manpower and organizational requirements for these great engineering works were tremendous, and the "Director," who was also the architect and engineer, enjoyed the highest possible rank in government and society, in contradistinction to the situation in all later history[4].

The Marib Dam

A very famous dam of antiquity was the Marib Dam, called by the Moslems Sudd el-Arim, located on the Wadi Sadd some 40 miles from the ancient city of Marib in the Kingdom of Yemen, in the southeastern part of the Arabian Peninsula. See Fig. 1. Marib may have been the capital over which the Queen of Sheba ruled, probably around 950 B.C. The Queen of Sheba is first mentioned in the Old Testament in the tenth chapter of the First Book of Kings, which tells of her famous visit to King Solomon in Jerusalem. Without doubt her visit to King Solomon was an extremely important event because of the gold, precious stones, and spices that she brought to him. This famous meeting is the source of some most interesting legends that have been handed down through the centuries by inhabitants of the area. Notwithstanding recent great advances in archaeology, apparently all we really know about the Queen of Sheba is found in the Bible.

Wendell Phillips[5] has written a fascinating book entitled *Qataban and Sheba* in connection with his explorations of the ancient kingdoms on the Biblical spice routes of Arabia. Included in this book, among other things, are photographs and a description from personal inspection of the ruins of the great Marib Dam. According to Phillips the original dam, considered one of the wonders of the ancient world, was probably constructed as the Kingdom of Sheba approached its most powerful period around 1000 to 700 B.C. It is interesting to note that Phillips in this book refers to the area as Sheba and to the inhabitants as the people of Sheba, whereas the *Encyclopedia of Islam*[6] calls the area Saba and the inhabitants Sabaeans.

The *Encyclopedia of Islam* contains a description of the ruins of the dam and appurtenant irrigation structures. It appears that there was a series of dams which controlled the Wadi Sadd, a fair-sized river draining the eastern slopes of a high mountain range in Yemen, the largest of the structures being the Marib Dam at the head of the valley. Intake sluices for the canals are still intact in each abutment. These canals followed each side of the valley to distribution centers. Nothing is left of the canals which distributed the water to the fields.

From the description in the *Encyclopedia of Islam* it appears that the great stone walls of the dam were formed by huge stones so perfectly dressed that they fitted into each other like pieces of a jigsaw puzzle. The hewn stones were so laid that at intervals long stones extended crosswise thus giving the otherwise parallel layers great cohesion. The stones were held together by little blocks of lead about 10 cm (centimeters) high and about 10 sq cm in section. These little rods of lead were placed in holes specially made for them about 4 or 5 cm deep, and the next block above was so placed that the corresponding cavity was filled with the top half of the little rod.

As in the case of the Sadd el-Kafara Dam in Egypt, no mortar of any kind was used to bind the layers of masonry. However, both in Egypt and in the Kingdom of Sheba, the engineers and artisans knew the use of mortar at that time. At the Marib Dam mortar was used as a covering on top of the dam to prevent damage from rain water. According to Phillips, parts of the main dam more than 50 ft in height are still occupying the same position in which Sheba's artisans placed them about 2,700 years ago.

History records that King Sharahbil Yafur in 449 A.D. had the works thoroughly renovated, but the effect lasted barely a year. In 450 A.D. the waters broke through the dam again, and a complete renovation was required. Once more the collapse of the great system could not be prevented. Under the rule of the Abyssinian Viceroy, Abraha, another breach occurred in 542 A.D. Another restoration of the works on a large scale averted disaster. The final catastrophe must have occurred not long after, and the fertile plain of Saba was transformed into a barren desert. There seems to be general agreement that the last disastrous breach in the dam occurred between 542 and 570 A.D.

The importance of the Marib Dam for the prosperity of the area is evident from the descriptions of the Arab historians and geographers who, in this connection, usually quote the reference in the Koran to "the two great gardens of the Sabaeans." According to Al-hemdani, this irrigated area not only included the Plain of Saba but stretched to the borders of the Desert of Saihad. Al-Masudi describes the land of Saba, with its wealth of gardens and fields, broad meadows and extensive irrigation works, as the most fertile part of Yemen, the beauty of which had become proverbial throughout the then known world.

Under such circumstances it was natural that the catastrophic bursting of the dam, known as Sadd el-Arim throughout the Moslem world, should have the most far-reaching effects. The *Encyclopedia of Islam* comments as follows on the catastrophe: "There is hardly any historic event of pre-Islamic history that has become embellished with so much that is fanciful, and related in so many versions, as the history of the bursting of the Marib Dam." The Mohammedan sacred scripture, the Koran, tells how "the people of Saba had beautiful gardens with good fruit. Then the people turned away from God, and to punish them, He burst the dam, turning the good gardens into gardens bearing bitter fruit."

Irrigation in the Central Negev

The ancient farmers that apparently were so successful in developing irrigation agriculture around the beginning of the Christian Era must have been well versed in the wise use of water. Yehuda Kedar, in the June 1957 issue of the *Geographical Journal*, describes in considerable detail an irrigation development that today would surely be considered submarginal. The development was located in the Central Negev of Israel, where a successful agriculture of a very advanced type was created and flourished between the 2nd Century B.C. and the 7th Century A.D.[10] The annual rainfall, averaging about 4 in., is limited to around 15 days per year, but during this 15-day period the rainfall is at times quite heavy. Low rubble masonry dams and small canals were used in such a manner as to capture and retain practically all the very limited precipitation and runoff.

According to Kedar, no less than 17,000 dams were found in a sample area of 50 sq miles. Most of the dams used by these ancient agriculturists were small, from 100 to 150 ft long, and 5 or 6 ft in height; however remains of structures in the larger wadies indicate that dams having a base width of 20 to 25 ft were built out of large stones in the shape of an arc, convex upstream. Although physical and climatic conditions were then much the same as today, the arid and mountainous region of the Central Negev supported at least six cities, each of which had a population ranging between 3,000 and 6,000.

Ancient Persian irrigation works

The history of Babylonia and Assyria shows that irrigation was actively practiced in the Tigris and Euphrates River basins (Fig. 1) as early as 2100 B.C. On the Tigris alone there were two great systems of irrigation starting from the final rapids near Beled, where the Tigris enters its delta.[7] The two systems involved the Nahrwan Canal on the left bank and an equally large, but not so long, canal on the right bank known as the Dijail Canal. Traces of the gigantic Nahrwan Canal, which was 400 ft wide and 15 ft deep, can still be identified today from the air as it stretches across the countryside for many miles. It extended for about 250 miles along the left bank of the Tigris and irrigated an area averaging 18 miles in width. Other important canals diverted water from the lower Euphrates but none were as large or involved engineering problems of such magnitude as the Nahrwan Canal.

According to local tradition, Nimrod, the mighty hunter and founder of the Biblical city of Nineveh, dammed the Tigris River by a massive earthen embankment, raised its level some 40 ft, and diverted it over the hard conglomerate so that it could flow at a high level and irrigate the whole country. It is quite possible that Nimrod also may have constructed a large canal along the edge of the alluvial valley of the Tigris, a short distance upstream from the city of Mosul, located on the opposite bank of the river from the site of ancient Nineveh. Traces of this canal are shown clearly in one of the accompanying photographs.

At some time during its 3,000-year period of use, the flow of the Tigris may have been diverted into the Nahrwan Canal by means of an earth dam. However, the ruins of massive rubble weirs can still be seen in the bed of the Tigris near the location of the ancient headworks. Thus masonry structures were also used for control of the headworks; in fact, imposing masonry structures, similar in construction to the Marib Dam in Yemen, were used to divert small tributaries such as the Atheim into the Nahrwan Canal. Sections of the Atheim masonry diversion dam were still in evidence at the beginning of the twentieth century, as seen in an accompanying illustration.

For the first 9 miles of its course, the ancient Nahrwan Canal was cut through a hard conglomerate in the shape of a trough some 50 ft deep and 65 ft wide.[4] The water in the canal flowed down this cut like a mill race, but after the first 9 miles it assumed a wider cross section and the more normal slope of an irrigation canal. The evidence indicates that during the thirteenth or fourteenth century the main stream of the Tigris deserted its ancient bed, followed the scoured and degraded bed of the canal, whose regulating head had been swept away, and cut out a new channel for itself at right angles to its old course. Once the river had changed its course, its old bed gradually silted up, and it ate away the feeder canal at the site of the regulator whose ruins today are in the bed of the Tigris. After following the canal for a distance

Marib Dam, one of the wonders of ancient times, was begun about 2700 years ago, as Kingdom of Sheba in southwest Arabia approached its most powerful period. Dam burst about 6th century A.D. Photo by William Terry from "Qataban and Sheba," © 1955, by Wendell Phillips. Used by permission of Harcourt, Brace and Co., Inc., New York (Ref. 5 in bibliography).

Oldest dam in the world as far as we know is Sadd el-Kafara, "Dam of the Pagans," built near Cairo, Egypt, between 2950 and 2750 B.C. Photo courtesy "The Geographic Journal" of the Royal Geographic Society, London (Ref. 2 in bibliography).

of about 4 or 5 miles, the river broke through the right canal bank and rejoined its original channel. These changes no doubt occurred during an unusually large flood. Traces of the old river channel can still be seen on the ground and can be identified on recently prepared topographic maps.

Irrigation in ancient Chaldea, or Babylonia, was at its zenith in the time of the Sassanian Kings of Persia, in the early centuries of the Christian Era (226-636 A.D.). It has been estimated, based on the ruins of ancient cities and other irrigation works, that the area supported a population of over 12 million people. The present population of the Kingdom of Iraq is about 5 million. It is said that the Nahrwan Canal irrigated the plains on which King Nebuchadnezzar (606-539 B.C.) erected his golden image.

In 539 B.C. Cyrus the Great, King of Persia, defeated the Babylonian Army led by the young Crown Prince Belshazzar, the son of Nebuchadnezzar.[8] Cyrus needed land for his Persian troops but the area irrigated by the Tigris and Euphrates systems was thickly populated. He therefore undertook to bring the Diyala, a tributary of the Tigris, under control for irrigation purposes. The stream normally flows in a sandy and mobile bed and carries a substantial volume of water during certain periods of the year. According to historical records, Cyrus dug 30 canals, divided the water among them, and closed the river by an earthen dam, thus completely controlling it. It was a striking example of the truth of the proverb, "Divide and conquer."

In 331 B.C. Alexander the Great invaded the country. Greek historians record that before his navy could sail up the rivers, the dams across them had to be removed. It is stated that Alexander partially removed massive rubble weirs placed across the Tigris near the head of the canal system in order to secure the conquest of the country. When the conquest was completed, he undoubtedly restored them. Alexander was so struck by the potentialities of irrigation in the Tigris and Euphrates delta that he was planning to rebuild the Tower of Babel and make Babylon the capital of his world. However, on his return to Babylon in 323 B.C., after his conquest of India, he became ill and died within three days at the age of 33.

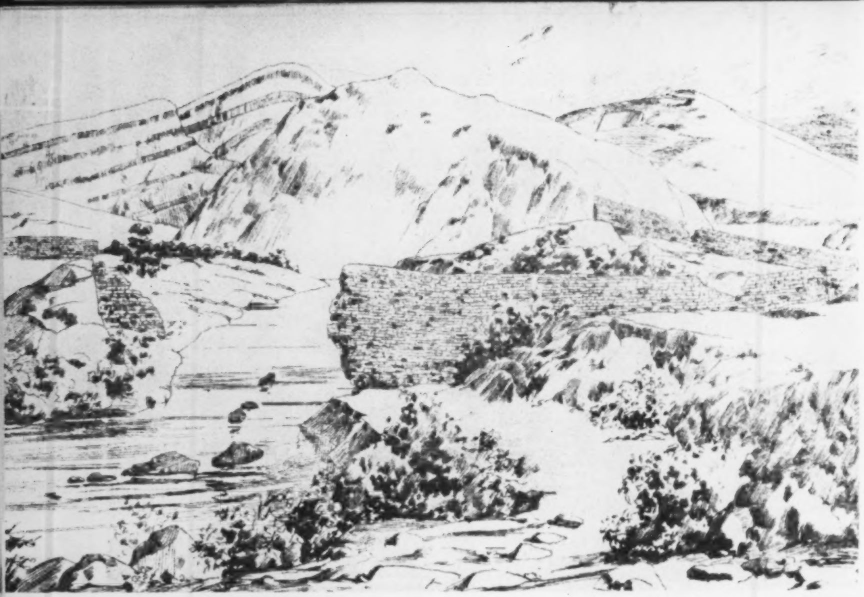
In the 7th century the Arabs overthrew the Sassanians of Persia. But under the Arabs the country steadily declined in prosperity. The final blow came in 1258 A.D. when Hulagu Khan with his Mongols sacked Baghdad and wiped out Arab rule. In the anarchy and confusion that ensued, all the great works of antiquity were swept away, one after another. It was during this period that the control structures on the great Nahrwan Canal failed, leaving the canals dry and waterless. Both banks of the Tigris became a desert. All the canals taking water from the Euphrates which had come down from a remote antiquity, were silted up and ceased to run. The Tigris and Euphrates, left to themselves, deserted the highlands they had irrigated for several thousand years and are now traversing the lowlands and marshes.

It would certainly be remiss to leave the impression that conditions existing around the turn of the century still prevail in modern Iraq. The Development Board of Iraq, using funds derived primarily from the country's enormous oil resources, has under way a program for restoring to their former productivity the lands irrigated by the Nahrwan Canal. These lands, in the *Kitab el Akalim*, written about 970 A.D., are described as "flowing amid continuous extensive villages, date groves and well-cultivated lands. . . ."

Bhojpur Lake, India

In India irrigation has been practiced since the dawn of civilization, and many remains of ancient works can still be seen there as well as in Ceylon. One of the most fascinating projects for the storage of a large volume of water involves the former Bhojpur Lake.[9] This ancient lake had an area of 250 sq miles and was located about 20 miles south of the city of Bhopal, in north central India. See Fig. 1.

According to tradition, the project was constructed by Raja Bhoj of Dhara. Raja Bhoj was stricken with a severe illness, some say leprosy, which the court physicians failed to remedy. He consulted a holy recluse who lived at a distance but was widely famed for his miraculous cures. The monk, after considering the case and performing many incantations and examinations of signs and omens, gave the following decree: the King would die of the



Stones of Atheim Dam, it is said, were laid without mortar and held together by lead dowels. This once imposing masonry structure was used to divert Atheim River into Nahrwan Canal in ancient times. As here seen, parts of it were still in evidence at beginning of 20th century. Drawing courtesy National Printing Dept., Cairo, Egypt (Ref. 7 in bibliography).

disease unless he was able to construct a lake so great as to be the largest in India, fed by 365 streams, or one for every day in the year. By bathing in such a lake, on a certain day, at a certain hour, he would be healed—not otherwise.

The King gathered together all his scientists and engineers and after a long and weary investigation and many failures and immense expenditures, they discovered a valley, subsequently inclosed, in which were the headwaters of the holy river, Betwa. There was only one problem—they could locate only 359 springs and streams flowing into the valley. This difficulty was overcome by diverting a stream from an adjoining valley, the river Kaliasot. It is of interest to note that the runoff of the Betwa was insufficient to fill the valley through which it flowed, so the Kaliasot not only increased the tributary streams to the magic number of 365 but also, with its 500 sq miles of additional area, provided the runoff necessary to fill and maintain the lake.

The topography of the area was most unusual in that only two breaks were found in the line of hills that surrounded the basin, one a little more than 300 ft wide and the other about 1,500 ft wide. The Raja's engineers filled these openings with very remarkable dams, consisting of a center core of earth supported on the upstream and downstream faces by immense blocks of stone, laid one on the other without mortar, but according to tradition, fitting so closely as to be watertight. The two faces of rubble masonry sloped inwards from the base. The dam closing the smaller opening was 87 ft in height and 300 ft thick at the base; that spanning the 1,500-ft opening had a maximum height of 40 ft and was about 100 ft wide on top. Although the higher dam spanning the 300-ft opening is now a complete wreck, the 1,500-ft dam is still intact and continues to divert the river Kaliasot into the Betwa.

The dams were completed and the lake formed during the 11th century A.D. According to tradition it was a beautiful body of water, dotted with many picturesque islands. There is no record as to whether Raja Bhoj was cured of his severe illness after bathing in this 250-sq mile lake, but 500 years later Shah Hussain, the greatest of the Mandu Kings, destroyed the higher and shorter dam in order to utilize the bed of the lake for agriculture. The Gonds, a native tribe living in the thick jungle still surrounding this valley, confirm that it took an army of laborers three months to destroy the dam. Three years elapsed before the lake was empty and thirty years before its bed was fit for cultivation. At present the valley is one of the most fertile areas in all India.

An interesting feature in connection with this great project, constructed for therapeutic purposes, is that the Indian engineers of that time did not make the same mistake as some of the dam builders who preceded them in other ancient lands. They did not neglect to carve out a spillway through the solid rock of one of the lower hills some two miles distant from the largest dam. High-water marks on the sides of this ancient spillway show that the maximum level of the lake was within 6 ft of the top of the two dams. The location of the spillway—in solid rock two miles from the largest dam—and the evidence of a design capacity that prevented overtopping of the two dams over a period of 500 years, is an excellent demonstration, I believe, of the practical ability of the Hindu engineers of the time.

Before concluding it may be of interest to briefly trace the art of dam building down to the present time.

The Romans were skilled in the design and construction of roads, aqueducts, bridges, water supplies, and structures of stone masonry. Although they did not construct dams to any great height, there is plenty of evidence still in existence of elaborate systems of low masonry dams. Along the coast of Tripolitania (Libya) a number of wadis which rise in the high Jebel Nefuza Mountains to the south carry large quantities of water and sediment into the Mediterranean each winter. Three great cities of Roman times, Leptis Magna, Oea, and Sabratha were situated near the mouth of these wadis. The Roman system of masonry dams in the wadis behind these towns was admirably adapted, not only to provide a permanent water supply for the towns themselves, but also to counteract soil erosion. An outstanding feature of the system was that the Romans brought the wadis under control at the headwaters first.

While Western Europe was passing through a period of intellectual darkness following the downfall of the Roman Empire, science and technology were flourishing in Islam. The Arabs applied science to the practical arts and crafts. The Moors who invaded southern Spain in 711 A.D. are credited with bringing the knowledge of dam building to southern Europe.[12, 13] In southern Spain, as in North Africa, the chief problem was water, and this was solved in a way that has hardly been improved upon since.

The great skill of the Moors in the use of water is best displayed at the Alhambra in their ancient capital at Granada. Here water was even made to run down the massive tiled railing of a long series of stone steps. The glazed and colored tiles filled with flowing water along the paths and around the borders of flower beds, the pools, the fountains, and the little jets that spray the tiled paths, still demonstrate for the modern tourist the genius of the Moors in manipulating water.

The Moors were driven out of Spain in 1492 A.D. Shortly thereafter, about the 16th century A.D., large masonry dams were constructed in Spain for irrigation purposes. According to Wegmann,[12] "Much as these early masonry dams excite our imagination by their great dimensions and massiveness, their proportions demonstrate that their designers had no correct conception of the forces to be resisted."

Despite their lack of scientific knowledge, the sixteenth century Spanish dam builders were far more advanced than their contemporaries in other parts of the world. These early Spaniards brought the art of dam building with them to their colonies in America. A great many dams were constructed in the semi-arid plateau regions of Mexico. Many have been in operation for more than two hundred years.[14]

The art of dam building has advanced rapidly during the past one hundred years, principally as a result of scientific research. In past ages, dams performed an essential function in advancing civilization and in bringing higher standards of living, and they are continuing to do so today throughout the world. One wonders what the historians of 3000 A.D. will have to say about the dam designers and builders of the 20th century.

(This article is based on the paper presented by the writer at the ASCE Hydraulics Division Conference at Massachusetts Institute of Technology in August 1957.)

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ENGINEERS' NOTEBOOK

Turn-of-nut method for tensioning bolts

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A simplified "turn-of-nut" method for installing A-325 high-strength bolts has been developed and currently is being demonstrated to fabricating and erection engineers of Bethlehem Pacific Coast Steel Corporation.

Since the development of high-strength bolts as structural fasteners five years ago, their use has rapidly become an accepted practice within the fabrication industry. The advantages over the rivet are many. Briefly high-strength bolts offer strength unparalleled by other fastening methods. They are more economical, have a higher clamping force, require less equipment and scaffolding in installation, and take less physical effort and skill than riveting. Bolting eliminates fire and attendant hazards and affords personal safety to erection crews.

The Research Council on Riveted and Bolted Structural Joints was responsible primarily for the development of high-strength bolts in structural applications. In its specifications for the assembly of structural joints using high-strength steel bolts, the Research Council set up a scale of minimum bolt tension values to which all nuts would be tightened, as follows:

Bolt Size, in.	Recommended Bolt Tension for Calibrating Wrenches, lb	Required Min. Bolt Tension, lb	Approx. Equivalent Torque for Required Min. Bolt Tension lb-ft
½	12,500	10,850	90
⅝	20,000	17,250	180
¾	29,000	25,600	320
⅞	37,000	32,400	470
1	49,000	42,500	710
1⅛	58,000	50,800	960
1¼	74,000	64,500	1,350

Three methods were suggested to achieve the proper tension:

1. Use of a manual torque wrench (from which the required torque could be read from the wrench dial).
2. Impact wrenches calibrated to induce stalling of the wrench head when the nut was tightened to indicate proper tension in the bolt.
3. Use of manual wrenches of a length sufficient to exceed the equivalent torque required when the effective wrench length, in feet, is multiplied by the man-effort, in pounds.

Subsequently the Association of American Railroads investigated an installation procedure employing only manual wrenches to facilitate field erection in remote areas without compressed-air equipment. Experiments by the Association developed a "turn-of-nut" method by running up nuts finger-tight, then tightening the bolts one full turn of the nut. In structural joints, of course, before the tightening process is considered in effect in the "turn-of-nut" method, *all connected parts must be properly fitted.*

From the experiments of the Association of American Railroads, and tests of their own, Bethlehem engineers came up with a modified "turn-of-nut" method. This improved method of tightening, in the words of Bethlehem engineers, "is a method that is applicable to any situation even where there are joints containing bolts of two or three different diameters." This method does away with all the costly and time-consuming pre-preparation of calibrating wrenches and changing air pressures for different diameters and lengths of bolts. Also, it requires very little operator instruction.

The modified "turn-of-nut" procedure, as developed by Bethlehem engineers, calls for running the nut up to a snug position using an impact wrench, rather than the finger tightening process of the Railroad Association. From the snug position of the nut, the nut is given an additional one-half or three-quarter turn, depending on the length of the bolt. The wrench operator gages the amount of additional turn by 180-deg marks on the chuck of the wrench.

Bolting team uses modified "turn-of-nut" method to install high-strength bolts in column splices of First Western Building in Oakland, Calif. This 18-story structure was erected entirely by bolting and welding in the field.

The "turn-of-nut" method is based on the principle that tension in the bolt is not a function of the torque applied to the nut, but is a function of the elongation of the bolt itself. Elongation after the nut is snugged and parts have been fitted up, can be measured by the amount of turn of the nut.

The following is the procedure adopted by Bethlehem Pacific Coast Steel Corporation engineers:

1. Fair-up holes with enough pins to maintain dimensions and plumbness of the structure. Pins are not to be removed until bolts in all other holes have been tightened.
2. Install bolts in remaining holes.
3. Tighten a pattern of bolts as would be done for riveting, being sure that the connected parts are properly fitted.
4. Using the impact wrench, spin the nut of each bolt not used to fit-up to a *"snug"* condition, then continue to tighten it *at least* one-half to one turn, depending on the grip length. "Snug" is indicated by the wrench when it *starts* to impact.
5. Replace pins with bolts and tighten as in Item 4.
6. Check torque of each fit-up bolt with the impact wrench. Usually no further torquing is required. Some may require one-quarter turn.
7. Torquing crew should mark completed work with an identifying symbol.

If this "turn-of-nut" method is followed, no bolt will have less than the minimum specified tension.

In using the impact wrench to install and tighten A-325 bolts according to the "turn-of-nut" method, compressed air at regulated pressure is required at all times. For bolts of ⅝-in., ¾-in. and ⅞-in. diameter, air pressure should be 100 to 110 psi; for larger-diameter bolts, 110 to 130 psi. Should the work have a range of bolt diameters, pressure regulators can be used for the smaller bolt diameters to permit use of the same high-power wrench required for the larger bolts.

Compressed air should be delivered to an auxiliary air receiver through not less than a 2-in.-diameter hose or pipe line. The auxiliary air receiver should be located not more than 200 ft away from the tools.

Manifolds for the distribution of the air supply are best placed at the auxiliary air receiver outlets. Where pressure regulators are required, they are to be close-coupled with a pressure gage to a manifold outlet. Use Cash Acme type "B" or equal pressure regulating valves. Impact wrenches are connected to the air supply at the valve through a short ½-in. I.D. hose and enough ¾-in. I.D. hose to reach from the structural connection being bolted to the manifold outlet.

Air compressor size is determined by the number and capacity of the impact wrenches being used. Table I should be helpful in determining the size of compressors.

The nut turn required for bolts of the most common diameters and grip lengths, in inches, is as follows:

At Least ½ Turn		At Least ¾ Turn
Bolt Dia.	Bolt Grip	Bolt Grip
¾"	to 5"	Above 5" to 10"
⅞"	to 5"	Above 5" to 10"
1"	to 8"	Above 8" to 12"
1⅛"	to 8"	Above 8" to 12"
1¼"	to 8"	Above 8" to 12"

In the past five years, the development of high-strength bolts has meant one-half less man-hours than the ordinary riveting time. This modified "turn-of-nut" method will save more installation time, particularly on joints having bolts of more than one diameter, and different lengths.

The time-saving advantages of the modified "turn-of-nut" method can easily be visualized in the erection of a tier building where many points on the structure may have as many as three to five different diameters of bolts. If the calibrated-wrench method were employed to do the job, operators would have to be furnished with different impact wrenches, each one calibrated to a different bolt diameter, or they would have to take time to change the air pressure for each bolt diameter. Bolt sizes in a typical example might range from ¾ to 1¼ in. In changing from ¾-in. bolts to ⅞-in. bolts, pressure regulating valves would be required in the air lines and the pressure would have to be changed from, say, 50 to 75 psi. The next larger bolt size would require a change in pressure from 75 to 100 psi, and eventually to 125 psi or more.

Under the modified "turn-of-nut" method, once the connected parts are properly fitted, the operator merely turns each nut to a "snug" condition, then tightens it by at least one-half to one turn, using a single wrench operating at the most efficient operating air pressure.

TABLE I. Recommended compressor capacity for impact-hammer operation

Model Wrench	Consumption	No. of Wrenches Compressor Will Supply				
		105 cfm	160 cfm	210 cfm	315 cfm	500 cfm
I-R 538	65 cfm	2	3	4	6 to 7	10 or 11
CP-365, I-R 534	50 cfm	2 or 3	4	5	7 to 8	11 or 12
CP-610	35 cfm	3 or 4	6	8	11 to 12	17 or 18
CP-3630, single blow, I-R 514	30 cfm	3 or 4	6	8	11 to 12	17 or 18

AMERICAN SOCIETY OF CIVIL ENGINEERS

Chicago Convention

Sponsored by Illinois Section in cooperation with Central Illinois and Tri-City Sections

Hotel Sherman, Chicago, Ill. **February 24-28, 1958**

REGISTRATION

Hotel Sherman, Mezzanine Floor

Sunday, Feb. 23, 1:00 p.m. to 7:00 p.m.
Monday, Feb. 24, 9:00 a.m. to 7:00 p.m.
Tuesday, Feb. 25, 9:00 a.m. to 5:00 p.m.
Wednesday, Feb. 26, 9:00 a.m. to 7:00 p.m.
Thursday, Feb. 27, 9:00 a.m. to 8:30 p.m.
Friday, Feb. 28, 9:00 a.m. to 1:00 p.m.

Fee $5.00 (except women and students).

ADVANCE INFORMATION ON ATTENDANCE

Please assist the Chicago Convention committee by completing the coupon on page 114 to indicate your tentative plans for attending various sessions. The coupon should be mailed directly to:

Raymond S. Knapp, Chairman,
Registration Committee
Chief Planning Engineer
Chicago Park District
425 East 14th St.
Chicago 5, Ill.

This does not constitute registration. It will be necessary to register when you arrive at the Convention. Do not send payment for tickets. These may be purchased at the time of registration. Your help in furnishing this advance information will facilitate planning and will be appreciated greatly by the Convention committee.

HOTEL ACCOMMODATIONS

Headquarters for the Chicago Convention will be the Sherman Hotel, Randolph and Clark Streets, conveniently located within the Loop. Please send your reservation request early to assure space at the headquarters hotel. For convenience a special request form is provided on page 129. Late requests may be assigned to other nearby hotels.

ELECTRONIC COMPUTER DEMONSTRATION

Hotel Sherman Old Chicago Room

9:00 a.m. to 6:00 p.m.
Monday through Thursday

Five firms supplying electronic computer equipment suitable for use in various fields of civil engineering will participate in this first ASCE computer demonstration.

Demonstrations of calculations will afford an opportunity to observe first hand the new "small" engineering computers that are rapidly becoming as useful as the slide rule to the civil engineer.

AUTHORS' BREAKFASTS

Hotel Sherman Ruby Room

8:00 a.m. Monday through Thursday
Briefing sessions for speakers, discussers and program officials for each day will take place at breakfast on the morning of the same day. Friday personnel are invited to the Thursday breakfast. By invitation only.

Presiding: Robert B. Banks, Chairman, Program Committee and Eivind Hognestad, Chairman, Technical Program Subcommittee

ACI ANNUAL MEETING

The American Concrete Institute is holding its annual meeting, February 24 through 27, at the Morrison Hotel, two blocks from the Sherman. A number of ASCE-ACI sessions are planned jointly.

WOMEN'S HOSPITALITY ROOM

Hotel Sherman Gold Coast Room

Open 9:00 a.m. to 4:00 p.m. daily.
Coffee 10:00 a.m. to 11:00 a.m.
Hostesses will welcome and assist ladies attending the Convention. See Women's Program, page 74.

MONDAY MORNING

FEB. 24

Air Transport Division

9.30 a.m. Crystal Room

Presiding: William E. Downes, Jr., Director of Airports, Bur. of Aviation, Dept. of Public Works, Chicago

9:30 **Developments at O'Hare Field, Chicago**
Carter Manny, Architect, Naess & Murphy, Chicago.

10:15 **Municipal Financing of Airports**
Rollin F. Agard, Director of Finance, City of Kansas City, Mo.

11:00 **Jet Aircraft and the Airport-Community Noise Problem**
Adone C. Pietrasanta, Senior Engr., Bolt, Beranet and Newman, Inc., Cambridge, Mass.

Engineering Mechanics Division

9:30 a.m. Louis XVI Room

Presiding: D. H. Pletta, Member, Exec. Committee, Engineering Mechanics Div.

9:30 **The Strength of Very Slender Beams**
E. F. Masur, A.M. ASCE, Assoc. Prof. of Eng. Mech., Univ. of Mich., Ann Arbor.

10:00 **Effect of Deflection on Lateral Buckling Strength**
J. W. Clark, A.M. ASCE, Asst. Chief, and A. H. Knoll, Research Engr., Eng. Design Div., Aluminum Co. of America, New Kensington, Pa.

10:30 **Analysis of Continuous Beams by Fourier Series**
S. L. Lee, A.M. ASCE, Asst. Prof. of Civil Eng., Northwestern Univ., Evanston, Ill.

11:00 **Matrix Analysis of Beam Stresses and Flexibility**
R. W. Clough, A.M. ASCE, Assoc. Prof. of Civil Eng., Univ. of Calif., Berkeley.

Highway, Pipeline, Surveying and Mapping Divisions, Joint Session

9:30 a.m. Bal Tabarin Room

Presiding: Joseph B. Spangler, Secretary, Pipeline Div.

9:30 **Gas Pipeline Relocation, Casing and Lowering Jobs Occasioned by Highway Construction**

Clem D. Richardson, Asst. Supt., Transcontinental Gas Pipeline Corp., Houston, Tex.

10:00 **Hazards to Highway at Gas Pipeline Crossings**

R. Robinson Rowe, M. ASCE, Principal Bridge Engr., Calif. Div. of Highways, Sacramento.

10:30 **Pipeline Surveying and Mapping as Compared to Location and Mapping of Highways**

Thomas M. Lowe, Jr., J.M. ASCE, Thomas M. Lowe, Jr., and Associates, Atlanta, Ga.

11:00 **Route Engineering Applications of Sonne Continuous Strip Photography**

John M. Wolvin, Manager, Chicago Aerial Survey, Chicago.

11:30 **Film: "Underground Miracle"** Southern Natural Gas Co. (color-sound)

HIGHWAY DIVISION LUNCHEON

Monday, Feb. 24

12:30 p.m. Grand Ballroom

Presiding: J. P. Buckley, Secretary, Exec. Committee, Highway Div.

Speaker: George M. Williams, M. ASCE, Asst. Commissioner for Eng., U. S. Bur. of Public Roads, Washington, D. C.

Subject: Needs of the Interstate System of Highways as Estimated in 1957

Members, guests and friends of the ASCE are cordially invited to attend this luncheon.

Per plate, $4.50. Tickets for the luncheon must be purchased before 10:00 a.m. on Monday.

PIPELINE DIVISION LUNCHEON

Monday, Feb. 24

12.30 p.m. G. B. Shaw Room

Presiding: F. C. Culpepper, A.M. ASCE, Member, Exec. Committee, Pipeline Div.

Speaker: William R. Connole, Commissioner, Federal Power Commission, Washington, D. C.

Subject: Future Prospects for International Pipelines Between Canada and the United States

Members, guests and friends of the ASCE are invited to attend.

Per plate, $4.50. Tickets for the luncheon must be purchased before 10:00 a.m. on Monday.

MONDAY AFTERNOON

FEB. 24

General Session

2:30 p.m. Bal Tabarin Room

Electronic Computation

Presiding: Nathan M. Newmark, Chairman, Committee on Electronic Computation, Structural Div.

2:30 **Introduction**
N. M. Newmark, M. ASCE, Head, Dept. of Civil Eng., Univ. of Ill., Urbana.

2:40 **Electronic Computers as Engineering Tools**
John J. Kozak, A.M. ASCE, Senior Bridge Engr., Calif. Div. of Highways, Sacramento.

3:20 **Characteristics of Digital Computers**
John P. Nash, Manager, Information Processing Div., Lockheed Aircraft Corp., Missiles System Div., Sunnyvale, Calif.

4:00 **Development and Integration of Electronic Computation Into Highway Engineering Operations**
H. A. Radzikowski, Chief of Development, U. S. Bur. of Public Roads, Washington, D. C.

4:40 **Panel Discussion**
Speakers and members of Committee on Electronic Computation, Structural Division.

CORNELL UNIVERSITY ALUMNI DINNER

Monday Evening, Feb. 24

All Cornell University alumni are invited to meet for this dinner with their friends and guests. For information and reservations please contact John Gnaedinger (Phone: NA 2-7200).

ASCE-ACI GET-ACQUAINTED COCKTAIL PARTY

Monday Evening, Feb. 24

5:30 to 7:00 p.m. Skyline Terrace Room

This will be an excellent opportunity for members, guests and friends of the ASCE and ACI to meet in a location providing an excellent view of Chicago. Tickets for admission are obtainable at registration.

Numerous Alumni Dinners are scheduled to follow this event. Refer to announcements listed below for details.

NORTHWESTERN UNIVERSITY ALUMNI DINNER

Monday Evening, Feb. 24

All alumni of Northwestern University are invited to bring their friends to this dinner meeting. For information and reservations, please contact Robert B. Banks (Phone, UN 4-1900, Ext. 257).

PURDUE UNIVERSITY ALUMNI DINNER

Monday Evening, Feb. 24

7:00 p.m. Crystal Room

Purdue University Civil Engineering Alumni, and friends, are invited to this alumni dinner. Reservations, with checks for $6.00 per person, should be mailed to G. H. Teletzke, Civil Engineering Building, Purdue University, West Lafayette, Ind.

UNIVERSITY OF ILLINOIS ALUMNI DINNER

Monday Evening, Feb. 24

7:00 p.m. Bal Tabarin Room

All University of Illinois alumni and their friends are invited to this dinner meeting. For information and reservations please contact Theodore Schroeder (Phone, RA 6-4354).

TUESDAY ALL-DAY FIELD TRIP

Feb. 25

Pipeline Division

Departure: 9:00 a.m. from Sherman Hotel by bus.

Return: 4:00 p.m. to Sherman Hotel.

Trip: To inspect the Joliet Measuring Station and the Herscher Storage Field.

The Joliet Measuring Station is the terminal of the Natural Gas Pipeline and the Texas Illinois Pipeline. At this point, two banks of six 10-in. meter runs each insure an uninterrupted delivery of gas to Chicago. The station is located approximately three miles west and one mile south of Joliet, Ill.

The Herscher Field is located approximately fifty-five miles south and west of Chicago's city limits, and about sixteen miles south and west of the City of Kankakee. The domed reservoir bed consists of a highly porous and permeable stratum of sandstone 100 ft. thick, the highest point of which lies approximately 1,750 feet below ground level.

Cost: No charge. Bus transportation and box lunch served en route, furnished through courtesy of Natural Gas Pipeline Company of America.

Registration: At convention registration desk no later than 4:00 p.m. Monday, February 24.

TUESDAY MORNING

FEB. 25

Air Transport Division

9:30 a.m. Emerald Room

Presiding: Ronald M. White, Member, Exec. Committee, Air Transport Div.

9:30 **Thin-Bonded Concrete Resurfacing for Concrete Airfield Pavements**
William G. Westall, Engr., Highways and Municipal Bur., Portland Cement Assoc., Chicago.

10:15 **Development of Multiple-Wheel CBR Design Criteria**
C. R. Foster, A.M. ASCE, Chief, Flexible Pavement Branch, and R. G. Ahlvin, A.M. ASCE, Chief, Special Projects Sect., Waterways Experiment Sta., Corps of Engineers, Vicksburg, Miss.

11:00 **Blast Fences**
Temple A. Tucker, Lt. Col., U.S. Air Force

Construction Division

9:30 a.m. Louis XVI Room

Young Engineers in Construction

Presiding: John S. M. Zimmerman, Member, Program Committee, Construction Div.

9:30 **Changes in Curriculum to Provide Students with a Major in Construction**
Dudley Newton, M. ASCE, Head, Civil Eng. Dept., Wayne Univ., Detroit, Mich.

10:15 **How to Attract Young Engineers Into the Construction Field**
H. L. Conrad, M. ASCE, President, The Christman Co., Lansing, Mich.

11:00 **How to Keep and Advance Young Engineers in the Construction Field**
Walter L. Couse, M. ASCE, President, Walter L. Couse and Co., Detroit, Mich.

Engineering Mechanics Division

9:30 a.m. Bal Tabarin Room

Presiding: Walter J. Austin, Chairman, Technical Committee on Mathematical Methods, Engineering Mechanics Div.

9:30 **Dynamic Analysis and Response of Aircraft Arresting Systems**
R. S. Ayre, Prof. of Civil Eng., Johns Hopkins Univ., Baltimore, Md., and J. I. Abrams, J.M. ASCE, Asst. Prof. of Civil Eng., Yale Univ., New Haven, Conn.

10:15 **Water Distribution Problems Solved by Network Calculations**
L. M. Haupt, Prof. of Electrical Eng., Texas A. & M. College, College Station.

11:00 **Sea-Bottom Pressure Fields Produced by Yawed Vessels**
P. M. Fitzpatrick, Hydrodynamics Lab., Research Div., U. S. Navy Mine Defense Lab., Panama City, Fla.

Hydraulics Division

9:30 a.m. Crystal Room

Sponsored by Committee on Flood Control, Hydraulics Div.

Presiding: Joseph B. Tiffany, Jr., Secretary, Exec. Committee and Joseph I. Perrey, Member, Committee on Flood Control, Hydraulics Div.

9:30 **Floods in the Chicago Area**
Horace P. Ramey, M. ASCE, Chief Engr., The Metropolitan Sanitary Dist. of Greater Chicago.

10:15 **Radar for Rainfall Measurement and Storm Tracking**
Glenn E. Stout, Head, Meteorology Sect., Illinois State Water Survey Div., Urbana.

11:00 **Water Conservation as it Affects the Wisconsin River Valley**
Lewis L. Sheerar, Asst. to General Manager, Wis. Valley Improvement Co., Wausau, Wis.

Surveying and Mapping Division

9:30 a.m. Jade Room

Presiding: Milton O. Schmidt, Member, Exec. Committee, Surveying and Mapping Div.

9:30 **The Illinois and Michigan Canal State Property Survey**
Charles D. Mitchell, Chief of Surveying and Drafting, Chicago Dist. Office, Illinois Div. of Waterways, Chicago.

10:00 **Survey Operations for Richard I. Bong Air Force Base, Wis.**
Peter A. Machinis, A.M. ASCE, Chief, Survey Branch, Chicago Dist., U. S. Corps of Engineers, Chicago.

10:30 **Precise Surveys for Mackinac Bridge**
R. M. Boynton, Assoc. Engr., D. B. Steinman, Consulting Engr., New York, N. Y.

11:00 **European Education in Surveying and Photogrammetry**
H. Karara, Asst. Prof., and Gordon Gracie, Instructor, Dept. of Civil Eng., Univ. of Illinois, Urbana.

Waterways and Harbors Division

9:30 a.m. Grand Ballroom

Sponsored by Committee on Navigation and Flood Control Facilities and Committee on Research

Presiding: L. B. Feagin, Vice Chairman, Exec. Committee, Waterways and Harbors Div.

9:30 **Cal-Sag Navigation Project**
John B. W. Corey, Jr., M. ASCE, Colonel, Corps of Engineers, USA, Dist. Engr., U. S. Army Engr. Dist., Chicago.

10:00 **Railroad Bridge Alterations**
George W. Svoboda, Lt. Col., Corps of Engineers, USA, Deputy Dist. Engr., U. S. Army Engr. Dist., Chicago.

10:30 **Calumet River Lock, Calumet-Sag Navigation Project, Illinois**
William J. Santina, M. ASCE, Asst. Chief, Eng. Div., and Edwin G. Hoffman, A.M. ASCE, Chief, Design Branch, Eng. Div., U. S. Army Engr. Dist., Chicago.

11:00 **Model Studies of Sector-Gate-Type Locks with Special Reference to Calumet Lock**
Fredrick R. Brown, M. ASCE, Chief, Hydrodynamics Branch, U. S. Army Waterways Exp. Sta., Vicksburg, Miss.

TUESDAY AFTERNOON

FEB. 25

Construction Division

2:30 p.m. Louis XVI Room

Construction Activities in Chicago

Presiding: Warren N. Ricker, Vice Chairman, Exec. Committee, Construction Div.

2:30 **Chicago's Airport Construction Program**
William E. Downes, Jr., M.

WATERWAYS AND HARBORS, STRUCTURAL DIVS. LUNCHEON

Tuesday, Feb. 25

12:30 p.m. G. B. Shaw Room

Presiding: Leo H. Corning, Chairman, Exec. Committee, Structural Div., and Lawrence B. Feagin, Vice Chairman, Exec. Committee, Waterways and Harbors Div.

Speaker: John E. Linden, M. ASCE, Asst. Chief Engr., DeLeuw, Cather & Co., Chicago, Ill.

Subject: Lake Calumet Port Development.

All members, guests and friends of the ASCE are cordially invited to attend this luncheon.

Per plate, $4.50. Tickets for the luncheon must be purchased before 10:00 a.m. Tuesday.

ASCE, Director of Airports, Bur. of Aviation, Dept. of Public Works, Chicago.

3:15 **Planning and Construction of the Calumet Skyway**
John G. Duba, A.M. ASCE, Administrative Engr., Dept. of Public Works, Chicago.

4:00 **Design and Construction of the Prudential Building**
John P. Roche, Chief Structural Engr., Naess & Murphy, Chicago.

4:45 **Planning and Construction of Chicago's $50-Million Parking Program**
Dick Van Gorp, M. ASCE, Chief Engr., Bur. of Eng., Dept. of Public Works, Chicago.

Highway and Surveying and Mapping Divisions, Joint Session

2:30 p.m. Crystal Room

Photogrammetry in Highway Design

Presiding: J. E. Leisch, Chairman, Highway Div., Chicago Convention Program Committee

2:30 **Photogrammetry in Highway Design**
William T. Pryor, M. ASCE, Chief of Photogrammetry and Aerial Surveys, U. S. Bur. of Public Roads, Washington, D. C.

3:00 **Developments in Surveying Techniques and Their Relation to Photogrammetry**
P. F. Hopkins, A.M. ASCE, Partner, Maddox and Hopkins, Inc., Silver Spring, Md.

3:30 **Future Developments in Photogrammetry**
R. H. Sheik, Engr. of Aerial Survey and Electronic Computer Sect., Bur. of Location and Design, Ohio Dept. of Highways, Columbus, Ohio.

4:00 **Electronic Distance Measurement with the Tellurometer**
Floyd W. Hough, M. ASCE, Vice President, Tellurometer Inc., Washington, D. C.

4:30 **Progress Report of Committee on Highway and Bridge Surveys on Preparation of Manual**
Milton O. Schmidt, M. ASCE, Prof. of Civil Eng., Univ. of Illinois, Urbana.

Hydraulics Division

2:30 p.m. Gold Room

Sponsored by Committee on Hydrology, Hydraulics Div.

Presiding: Joseph Tiffany, Jr., Secretary, Exec. Committee, and W. E. Hiatt, Chairman, Committee on Hydrology, both Hydraulics Div.

2:30 **Evaporation of Lake Ontario**
Ira A. Hunt, Jr., J.M. ASCE, Capt., Corps of Engineers, U. S. Lake Survey, Detroit, Mich.

3:15 **Hydrology of Lake Ontario**
R. H. Clark, Dept. of Northern Affairs and National Resources, Water Resources Branch, Ottawa, Ontario.

4:00 **Currents and Water Masses of Lake Michigan**
John C. Ayers, Research Director; David C. Chandler, George H. Lauff, and Charles F. Powers, Great Lakes Research Inst. and Dept. of Zoology, Univ. of Mich., Ann Arbor; and E. Bennette Henson, Dept. of Zoology, Univ. of Maryland, College Park.

4:45 **Physical Limnology of Grand Traverse Bay**
G. H. Lauff, Great Lakes Research Inst., Univ. of Mich., Ann Arbor.

Structural Division

2:10 p.m. Bal Tabarin Room

Structural Aspects of Nuclear Reactor Design

Presiding: David Lee Narver, Jr., Chairman, Committee on Nuclear Structures and Materials, Structural Div.

2:10 **General Considerations—Reactors and Related Plant Types**
John F. Stolz, Supervisor, Eng. Design, Reactor Facilities, Atomics International Div., North American Aviation, Inc., Canoga Park, Calif.

2:50 **Stress Analysis in the Design of Nuclear Power Plants**
John Zickel, Stress Analysis Engr., Power Reactor Eng., General Electric Co., San Jose, Calif.

3:30 **Some Problems Associated with the Construction of Radiation Barriers in a Reactor Plant**
B. John Garrick, Chief Nuclear Scientist, Holmes and Narver, Inc., Los Angeles, Calif.

4:10 **Construction Techniques and Design Considerations**
Gibson Morris, Chief Engr., Eng. Dept., Oak Ridge National Lab., Oak Ridge, Tenn.

Waterways and Harbors Division

2:30 p.m. Grand Ballroom

Sponsored by Committees on Research and on Navigation and Flood Control Facilities

Presiding: L. B. Feagin, Vice-Chairman, Exec. Committee, Waterways and Harbors Div.

2:30 **Indiana Harbor Development**
Carl R. Swanson, Asst. to the Chief Engr., Youngstown Sheet and Tube Co., Youngstown, Ohio.

3:00 **The Port of Chicago**
Austin E. Brant, Jr., J.M. ASCE, Project Engr., Tippetts, Abbett, McCarthy, Stratton Eng. Co., New York, N. Y.

3:30 **Scientific Advances in River Equipment**
C. R. Horton, Jr., Chief Marine Engr., Eng. Works Div., Dravo Corp., Pittsburgh, Pa.

MICH. COL. OF MIN. AND TECH. ALUMNI DINNER

Tuesday Evening, Feb. 25

7:00 p.m. Dinner

All Michigan College of Mining and Technology Alumni attending the Convention, their wives and guests, are invited to this dinner meeting of the MCM Club of Chicago, at the North Shore Room, Toffenetti's Restaurant, 225 S. Wabash Ave. For information and reservations contact George Uitti, 228 N. La-Salle Street, Chicago (Phone, ST 2-6492).

MIT ALUMNI DINNER

Tuesday Evening, Feb. 25

5:30 p.m. Cocktail Hour
6:30 p.m. Dinner

All Massachusetts Institute of Technology Alumni are invited to attend this dinner meeting of the MIT Club of Chicago. For information and reservations, please contact Robert C. Meissner, c/o John F. Meissner Engineers, Inc., 300 W. Washington Street, Chicago (Phone, AN 3-1944).

WEDNESDAY MORNING FEB. 26

General Session

9:15 a.m. Bal Tabarin Room
Presiding: Louis R. Howson, President, ASCE

Welcome to Chicago: Richard J. Daley, Mayor, City of Chicago.
Response: Mr. Howson

Department of Conditions of Practice

Sponsored by Committee on Employment Conditions

Presiding: Norman R. Moore, Vice President, ASCE; Chairman, Dept. of Conditions of Practice

10:00 **Engineers, Unions, and the ASCE**
Robert D. Darragh, J.M. ASCE, President of Junior Forum, San Francisco Section.
Discussion

10:30 **Pension and Profit-Sharing Plans**
W. A. Berryman, Merchantile Trust Co., St. Louis, Mo.
Discussion

11:00 **Employment Conditions in Illinois**
Wes Wager, Professor, Univ. of Washington, Seattle.
Discussion

11:30 **How Are Employment Conditions?**
Jack Y. Long, M. ASCE, Partner and Chief Engr., J. Y. Long.
Discussion

WEDNESDAY AFTERNOON FEB. 26

Department of Conditions of Practice

2:30 p.m. G. B. Shaw Room

Presiding: Waldo G. Bowman, Vice President, ASCE

2:30 **How 7,000 High School Students Look Upon Engineering as a Career**
Bert C. Wilkas, A. M. ASCE, Chairman, San Diego Sect., Student Activities Committee.

3:15 **Discussion**
Finley B. Laverty, M. ASCE, Chief Hydraulic Engr., Los Angeles County Flood Control Dist.

3:30 **General discussion**

CONDITIONS OF PRACTICE LUNCHEON

Wednesday, Feb. 26

12:30 p.m. Grand Ballroom

Presiding: Frank W. Edwards, General Chairman, Chicago Convention

Speaker: Chuck Hanna

Subject: Freedom Is *Not* Free

The topic of this program is of the greatest interest to all citizens. Chuck Hanna is a lecturer, industrial consultant, and radio and TV commentator extraordinary. All members, their ladies, guests and friends of ASCE are urged to attend.

Per plate, $4.50. Tickets for this luncheon must be purchased before 10.00 a.m. on Wednesday.

Amer. Concrete Inst. and ASCE Structural Div., Joint Session

2:30 p.m.
Grand Ballroom, Morrison Hotel

Presiding: Phil M. Ferguson, Vice President, ACI and Chairman, ASCE Committee on Masonry and Reinforced Concrete

2:30 **Influence of Design and Details of Structures on Concrete Deterioration**
P. D. Miesenhelder, M. ASCE, M. ACI, Research Engr., Concrete, Assoc. of Amer. Railroads, Chicago.

3:00 **Effect of Axial Compression on Shear Strength of Reinforced Concrete**
J. W. Baldin, Jr., Instructor, Theoretical and Applied Mechanics Dept., Univ. of Illinois, Urbana; and Ivan M. Viest, J. M. ASCE, M. ACI, Bridge Research Engr., AASHO Road Test, Ottawa, Ill.

3:40 **Ultimate Shear Strength of Reinforced Concrete Members Without Shear Reinforcement**
Charles S. Whitney, M. ASCE, M. ACI, Partner, Ammann and Whitney, New York, N. Y.

4:20 **Development of Precast Concrete Girders Reinforced with High-Strength Deformed Bars**
J. R. Gaston, J. M. ASCE, M. ACI, Assoc. Development Engr. and Eivind Hognestad, A. M. ASCE, M. ACI, Manager, Structural Development Sect., Portland Cement Assoc., Chicago.

City Planning and Highway Divs., Joint Session

2:30 p.m. Louis XVI Room

Urban Transportation Problems

Presiding: Norman Kennedy, Chairman, Committee on Urban Transportation, Highway Div.

2:30 **Urban Transportation Problem, Report of Committee on Urban Transportation**
D. Grant Mickle, M. ASCE, Director, Traffic Eng. Div., Automotive Safety Foundation, Washington, D. C.

3:00 **Approaches to the Study of Urban Transportation**
R. L. Creighton, Asst. Director, Research and Planning, Chicago Area Transportation Study, Chicago.

3:30 **Planning Aspects as Applied to the Congress Street Expressway**
George DeMent, Commissioner of Public Works, Chicago.

4:00 **City Planning and Urban Renewal Aspects of Expressway Location.**
Charles Blessing, M. ASCE, Director of City Planning, Detroit Plan Commission, Detroit, Mich.

Hydraulics Division

2:30 p.m. Ruby Room

Sponsored by Committee on Hydromechanics, Hydraulics Div.

Presiding: Joseph B. Tiffany, Jr., Secretary, Exec. Committee, Hydraulics Div., and D. R. F. Harleman, Chairman, Committee on Hydromechanics, Hydraulics Div.

2:30 **Pressure Changes at Open Junctions in Conduits**
W. M. Sangster, J. M. ASCE, H. W. Wood, M. ASCE, and E. T. Smerdon, Univ. of Missouri, Columbia, Mo.; and H. G. Bossy, M. ASCE, U. S. Bur. of Public Roads, Washington, D. C.

3:15 **Scour Below a Cantilevered Outlet**
M. L. Albertson, M. ASCE, Prof. of Civil Eng. and Head, Fluid Mechanics Research, and G. L. Smith, A. M. ASCE, Graduate Student, Colorado State Univ., Fort Collins, Colo.

4:00 **Backwater at Bridge Constructions**
H. K. Liu, Colorado State Univ., Fort Collins; and J. N. Bradley,

M. ASCE, Hydraulic Engr., U. S. Bur. of Public Roads, Washington, D. C.

4:45 **Outlet Portal Pressure Distribution**
M. B. McPherson, A. M. ASCE, Philadelphia Water Dept., Philadelphia, Pa.; and A. R. R. Morel, former Gotshall Scholar, Lehigh Univ., Bethlehem, Pa.

Pipeline Division

2:30 p.m. Gold Room

Presiding: R. E. Kling, Chairman, Committee on Session Programs, Pipeline Div.

2:30 **Pipeline Field Welding and Quality Control Methods**
A. G. Barkow, Natural Gas Pipeline Co. of America, Chicago.

3:00 **Fluid Friction in Pipelines**
R. F. Bukacek, Instructor, Dept. of Chemical Eng., Illinois Inst. of Technology, Chicago.

3:30 **Feather River Project**
R. M. Edmonston, A. M. ASCE, Superv. Hydraulic Engr. and Edward Jackson, Calif. Div. of Water Resources, Los Angeles, Calif.

4:00 **Procedures for Testing Pipeline Efficiency**
J. N. White, Panhandle Eastern Pipeline Co., Kansas City, Mo.

4:30 **Film "Welding America"**
Natural Gas Pipeline Co. of America (color-sound).

Soil Mechanics and Foundations Division

2:30 p.m. Bal Tabarin Room

Sponsored by Committee on Earth Dams, Soil Mechanics and Foundations Div.

Presiding: T. M. Leps, Member, Exec. Committee, Soil Mechanics and Foundations Div.

2:30 **Application of Oil Field Drilling Techniques to Foundation Freezing at Gorge High Dam**
James N. Gregory, Consulting Engr., Long Beach, Calif.

3:15 **Soil Mechanics for Earth Dams**
Karl V. Taylor, M. ASCE, Supervising Engr., Bechtel Corp., Los Angeles, Calif.

4:00 **Design of Relief Well Systems for Levees**
P. T. Bennett, M. ASCE, Chief, Geology, Soils and Materials Branch, Missouri River Div., Corps of Engrs.; and R. A. Barron, A. M. ASCE, Office of Chief of Engrs., Corps of Engrs., Washington, D. C.

Power Division

2:30 p.m. Crystal Room

Dresden Nuclear Power Plant

Presiding: William A. Conwell, Chairman, Committee on Nuclear Energy, Power Div.

2:30 **Civil Engineering Aspects of the Dresden Nuclear Power Plant**
Joseph E. Love, A. M. ASCE, Engr., Project Eng.; Chester S. Darrow, J. M. ASCE, Architectural and Civil Engr., General Electric Co., San Jose, Calif.; and Burr H. Randolph, Senior Engr., Bechtel Corp., San Francisco, Calif.

3:30 **Design of the Spherical Containment Shell of Dresden Station**
Leonard Zick, A. M. ASCE, Chief Research Engr.; J. T. Dunn, Research Engr.; and J. B. Maher, Mechanical Engr., Chicago Bridge & Iron Co., Chicago.

ASCE-ACI DINNER DANCE AND ENTERTAINMENT

Wednesday Evening, Feb. 26

6:30 p.m. Social Hour, Louis XVI and Crystal Rooms

7:15 p.m. Dinner and Music, Grand Ballroom

Introductions of: Louis R. Howson, President, ASCE

Douglas McHenry, President, ACI

Vaudeville Acts

Dancing

Dress optional. Per plate, $9.50.

THURSDAY MORNING FEB. 27

Highway Division

9:30 a.m. Louis XVI Room

Keeping Studies of Highway Needs Current

Presiding: R. E. Jorgensen, Member, Committee on Highway Planning and Finance, Highway Div.

9:30 **Procedures for Making Continuing Inventories and Needs Studies for Illinois State Highways**
Theodore Morf, Engr. of Research and Planning, Illinois Div. of Highways, Springfield.

10:00 **Appropriate Bases for Continuing Inventories and Needs Studies**
R. E. Livingston, Manager, Planning and Research Div., Colorado Dept. of Highways, Denver.

10:30 **Procedures for Making Continuing Inventories and Needs Studies for California County Roads**
Mel West, Supervising Highway Engr., Calif. Div. of Highways, Sacramento.

11:00 **Experiences and Problems in Developing Construction Programs for Tennessee**
C. F. McCormack, M. ASCE, Deputy Chief Engr., Highways Div., Automotive Safety Foundation, Washington, D. C.

11:30 **Street and Highway Inventory Needs Studies for the City of Boston**
John Clarkeson, M. ASCE, Clarkeson Eng. Co., Boston, Mass.

Irrigation and Drainage Division

9:30 a.m. Gold Room

Presiding: Howard T. Critchlow, Chairman, Exec. Committee, Irrigation and Drainage Div.

9:30 **The Engineer and Worldwide Conservation of Soil and Water**
O. W. Israelsen, M. ASCE, Prof. Emeritus, Civil and Irrigation Eng., Utah State Agricultural College, Logan.

10:15 **Worldwide View of Irrigation Projects**
N. D. Gulhati, M. ASCE, Deputy Secy., Ministry of Irrigation and Power, Government of India, New Delhi, India.

11:00 **Irrigation Science in Relation to Irrigation Progress**
D. F. Peterson, Jr., M. ASCE, Dean of Eng., Utah State Univ., Logan.

Power Division

9:30 a.m. Gold Room

Nuclear Power

Presiding: G. J. Vencill, Member, Exec. Committee, Power Div.

9:30 **Civil Engineering Aspects of the Fermi Station**
J. D. Feldes, Health Physicist, Power Reactor Development Co., Detroit, Mich.; and P. C. Burg, A. M. ASCE, Engr., Commonwealth Associates, Inc., Jackson, Mich.

10:30 **Insurance Aspects of Nuclear Energy**
E. R. Lloyd, J. M. ASCE, Asst. Supt., Boiler and Machinery Dept., Royal-Globe Insurance Group, New York, N. Y.

Sanitary Engineering Division

9:30 a.m. Ruby Room

Water Supply

Presiding: Ray E. Lawrence, Vice Chairman, Exec. Committee, Sanitary Engineering Div.

9:30 **Design Features of Chicago's Central District Filtration Plant**
Fred G. Gordon, M. ASCE, Asst., Chief Engr., Bur. of Eng., Dept. of Public Works, Chicago.

10:15 **Planning the Future for Chicago's Water System**
W. W. DeBerard, Hon. M. ASCE, Deputy Commissioner for Water and Chief Water Engr., Dept. of Water and Sewers, Chicago.

11:00 **Proposed Changes in Eastern Water-Use Policies**
Murray Stein, Chief, Interstate Enforcement, Water Supply and Water Pollution Control Program, U. S. Public Health Service, Washington, D. C.

Soil Mechanics and Foundations Division

9:30 a.m. Bal Tabarin Room

Presiding: J. O. Osterberg, Secretary, Exec. Committee, Soil Mechanics and Foundations Div.

9:30 **Compression Behavior of Partially Saturated Compacted Soils**
Y. Yoshimi, J. M. ASCE, Research Associate Technological Inst., Northwestern Univ., Evanston, Ill.

10:00 **Effects of Repeated Loading on Strength and Deformation Characteristics of Compacted Clays**
H. B. Seed, A. M. ASCE, Assoc. Prof. of Civil Eng., Univ. of Calif., Berkeley; R. L. McNeil, J. M. ASCE, Woodward Clyde and Associates, Oakland, Calif.; and J. deGuenin, Univ. of Calif., Berkeley.

10:30 **Influence of Structure on the Engineering Properties of Compacted Clay**
T. William Lambe, M. ASCE, Assoc. Prof. of Soil Mechanics, Mass. Inst. of Technology, Cambridge.

11:00 **Computation of Settlement of Footings on Deep Clay Deposits**
Laurits Bjerrum, Director, Norwegian Geotechnical Inst., Oslo, and Visiting Prof., Mass. Inst. of Technology, Cambridge, Mass.

Structural Division

9:15 a.m. G. B. Shaw Room

Research Council on Riveted and Bolted Structural Joints, Eng. Foundation

Presiding: Elmer Timby, Member, Exec. Committee, Structural Div.

9:15 **Rivet and Bolt Council Research**
Emerson J. Ruble, M. ASCE, Research Structural Engr., Assn. of Amer. Railroads, Chicago.

9:40 **Strength of Rivets and Bolts in Tension**
William Munse, Jr., A. M. ASCE, Research Prof.; Kenneth S. Petersen, Research Asst.; and Eugene Chesson, Jr., J. M. ASCE, Research Assoc., Civil Eng., Univ. of Illinois, Urbana.

10:20 **Behavior of Riveted and Bolted Beam-to-Column Connections**
William H. Munse, Jr., A. M. ASCE, Research Prof.; W. G. Bell, J. M. ASCE, Research Asst.; and Eugene Chesson, Jr., J. M. ASCE, Research Assoc., Civil Eng., Univ. of Illinois, Urbana.

11:00 **Fatigue Properties of High-Strength Steel in Riveted and Bolted Joints**
N. G. Hansen, Office of Chief of Engrs., Eng. Research and Development Div., Washington, D. C.

CONVENTION LUNCHEON

Sponsored by Committee on Research

Thursday, Feb. 27

12:30 p.m. Grand Ballroom

Presiding: Elmer K. Timby, Chairman, Committee on Research.

Speaker: Martin A. Mason, M. ASCE, Dean, The School of Eng., George Washington Univ., Washington, D. C.

Subject: The Responsibility of a Profession for Developing New Knowledge.

ASCE Research Prizes to be awarded to:

M. J. Hvorslev, M. ASCE, Consultant, Waterways Exp. Sta., Corps of Engineers, Vicksburg, Miss.

Bruce G. Johnston, M. ASCE, Civil Eng. Dept., Univ. of Florida, Gainesville.

Lorenz G. Straub, M. ASCE, Director, St. Anthony Falls Hydraulic Lab., Minneapolis, Minn.

All ASCE members and guests are urged to attend this important event.

Per plate, $4.50. Tickets for this luncheon must be purchased before 10:00 a.m. on Thursday. Students who are registered at the Convention may obtain luncheon tickets for $2.50.

STUDENT PROGRAM

9:30 a.m. Emerald Room

Careers for Civil Engineers

Moderator: William F. Trezise, Dean of Eng., Chicago Undergraduate Div., University of Illinois

Panel discussion

Government
Russell A. Thompson, Executive Asst. to Div. Engr., Chicago Div. of Great Lakes Dist., U. S. Engineers.

Utility
Cecil J. McLean, M. ASCE, General Hydraulic Engr., Commonwealth Edison Co.

Consulting
Bruce M. Johnson, M. ASCE, Section Head, Harza Eng. Co.

Construction
Frank J. Herlihy, President, Herlihy Mid-Continent Co.

Manufacturing and Sales
Orlando William Irwin, A.M. ASCE, President, Rail Steel Bar Assoc.

Research and Academic
Robert L. Janes, A.M. ASCE, Asst. Manager, Mechanical Eng., Armour Research Foundation.

THURSDAY AFTERNOON FEB. 27

Highway Division

2:30 p.m. Louis XVI Room

Road Tests

Presiding: William A. McWilliams, Chairman, Exec. Committee, Highway Div.

2:30 **History and Significance of Road Tests**
Edwin A. Finney, M. ASCE, Research Engr., Mich. State Highway Dept., East Lansing, Mich.

3:00 **Large-Scale Highway Research—AASHO Road Test**
W. B. McKendrick, Jr., M. ASCE, Project Director, AASHO Road Test Project, Ottawa, Ill.

3:30 **The Research Phase of the AASHO Road Test**
William N. Carey, Jr., M. ASCE, Chief Engr. for Research, AASHO Road Test Project, Ottawa, Ill.

4:00 **Looking Ahead at Vehicle Design**
K. A. Stonex, Asst. Director, General Motors Proving Grounds, Milford, Mich.

4:30 **Tests on Open-Graded Sand and Gravel Subbases for Concrete Pavement**
L. D. Childs, Senior Development Engr., Transportation Development

Sect., Portland Cement Assn., Chicago; and J. W. Kapernick, A.M. ASCE, Miller-Warden Associates, Chicago.

Irrigation and Drainage Division

2:30 p.m. Gold Room

Presiding: John H. Bliss, Chairman, Session Program Committee, Irrigation and Drainage Div.

2:30 **Frequency and Extent of Droughts in Humid Areas**
Gerald Barger, General Area Climatologist, U. S. Weather Bur., Ames, Iowa.

3:15 **Potential Use of Water by Irrigation in Humid Areas**
Keith H. Beauchamp, Irrigation Engr., U. S. Soil Conservation Service, Milwaukee, Wis.

4:00 **Problems in Preparing a Conservation of Water Resources Act**
William J. Pierce, Prof. of Law, Univ. of Michigan, Ann Arbor.

Power Division

2:30 p.m. Emerald Room

Presiding: G. J. Vencill, Member, Exec. Committee, Power Div.

2:30 **Value of Efficiency, Index and Acceptability Tests for Hydroelectric Generating Units**
Committee on Operation and Maintenance of Hydroelectric Generating Stations; M. G. Salzman, M. ASCE, Chairman, Committee on Progress in Power Plant Design.

3:30 **Fixed-Wheel Gates for Penstock Intakes**
S. J. Skinner, Mechanical Engr., U. S. Bur. of Reclamation, Denver, Colo.

Sanitary Engineering Division

2:30 p.m. Bal Tabarin Room

Sewerage and Sewage Treatment

Presiding: Thomas M. Niles, Program Chairman, Chicago Sessions, Sanitary Engineering Div.

2:30 **Recent Developments in the Chicago Sanitary District**
Norval E. Anderson, M. ASCE, Engr. of Treatment Plant Design, The Metropolitan Sanitary Dist. of Greater Chicago.

3:15 **The Hydrology of Urban Runoff**
Albert L. Tholin, M. ASCE, Chief Sewer Engr., and Clint J. Keifer, A.M. ASCE, Civil Engr., Bur. of Eng., Dept. of Public Works, Chicago.

4:00 **Sleuthing the Behavior of a River—Some Practices in the Art of Water Quality Monitoring on the Ohio**
Edward J. Cleary, M. ASCE, Exec. Director and Chief Engr., Ohio River Valley Water Sanitation Commission, Cincinnati, Ohio.

Soil Mechanics and Foundations Division

2:30 p.m. Crystal Room

Presiding: R. B. Peck, Member, Exec. Committee, Soil Mechanics and Foundations Div.

2:30 **Soils Engineering on the Illinois Toll Highway**
David Novick, A.M. ASCE, Exec. Vice President, Goodkind and O'Dea, Inc., Chicago.

3:00 **Recent Developments in Foundation Practice in the Chicago Area**
Sidney Berman, A.M. ASCE, Soils Engr., Dept. of Public Works, Chicago

3:30 **Soil and Foundation Problems of the Chicago Central District Filtration Plant**
George S. Salter, M. ASCE, Chief Filtration Engr., Dept. of Public Works, Chicago.

4:00 **Subsoil Conditions in the Northern Indiana Industrial Area**
J. O. Osterberg, M. ASCE, Prof. of Civil Eng., Technological Inst., Northwestern Univ., Evanston, Ill.

Structural Division

2:30 p.m. G. B. Shaw Room

Research Council on Riveted and Bolted Structural Joints, Engineering Foundation

Presiding: George Vincent, Vice Chairman, Exec. Committee, Structural Div.

2:30 **Effects of Fabrication Techniques on Bolted Joints**
Desi D. Vasarhelyi, A.M. ASCE, Assoc. Prof.; Said Y. Beano, Graduate Student; and Ronald B. Madison, J.M. ASCE, Zung-An Lu, Umesh C. Vesisth, former graduate students, Univ. of Washington, Seattle.

3:10 **Tightening High-Strength Bolts in Structures**
E. F. Ball, M. ASCE, Chief Engr.; and J. J. Higgins, Supervisor of Erection, Tool Houses and Safety, Fabricated Steel Construction, Bethlehem Steel Co., Bethlehem, Pa.

4:00 **Experience with High-Strength Bolts in Mackinac Straits Bridge**
John W. Kinney, Resident Engr., D. B. Steinman, Consulting Engr., New York, N. Y.

STUDENT PROGRAM

2:30 p.m. Jade Room

Tours to Engineering Offices

Arrangements have been made with local engineering offices for students in small groups to visit them to observe different types of work and organizations.

MEN'S SMOKER AND SHOW

Thursday Evening, Feb. 27

8:00 p.m. Bal Tabarin Room

A gala evening for informal sociability, excellent entertainment, refreshments to suit a man's palate, and the chance to chat with friends and business associates—this is the reputation well earned by the smoker.

8:00-9:00 p.m.: Warm-up

9:00-10:00 p.m.: An enjoyable show consisting of light, comical, entertaining acts

10:00 to closing: Sandwiches, snacks, beer and coffee. Bar service also.

Per person, $4.50. (Students who are registered at the Convention may obtain tickets for $2.50 for this smoker.)

FRIDAY MORNING FEB. 28

Irrigation and Drainage Division

9:30 a.m. Jade Room

Presiding: M. C. Boyer, Hydraulic Engr., Indiana Flood and Water Resources Commission, Indianapolis

9:30 **Multiple-Use Projects in Development of Water Resources**
W. A. Dexheimer, M. ASCE, Commissioner, U. S. Bur. of Reclamation, Washington, D. C.

10:15 **Storage for Control and Regulation of Water Supplies in Humid Areas**
T. H. Quackenbush, U. S. Soil Conservation Service, Washington, D. C.

11:00 **Modern Equipment and Techniques in Relation to Irrigation and Drainage Construction**
E. A. Braker, Supervisor of Sales Eng., Construction Equipment Div., International Harvester Co., Melrose Park, Ill.

Sanitary Engineering Division

9:30 a.m. Bal Tabarin Room

Refuse Disposal and Air Pollution

Presiding: Ray E. Lawrence, Vice-Chairman, Exec. Committee, Sanitary Engineering Div.

9:30 **Design and Construction of Chicago Incinerators**

Theodore C. Eppig, Supt., Bur. of Sanitation, Chicago.

10:15 **Refuse Incineration Practice**
Samuel M. Clarke, M. ASCE, Partner, Greeley and Hansen, Chicago.

11:00 **Techniques and Results of Air Pollution Studies**
August T. Rossano, Chief, State and Community Services, Community Air Pollution Program, U. S. Public Health Service, Cincinnati, Ohio.

FACULTY ADVISERS CONFERENCE

Friday Morning, Feb. 28

9:00 a.m. Room 107

Presiding: Thomas Stelson, Member, Committee on Student Chapters

9:00 **Outline of Conference Objectives**
Thomas Stelson, J.M. ASCE, Member, Committee on Student Chapters.

9:15 **Remarks by Louis R. Howson, President ASCE**

9:30 **Activities of the Society Through Its Board of Direction with Special Reference to Student Chapters**
Clarence L. Eckel, M. ASCE, Dean, College of Eng., Univ. of Colorado, Boulder.

10:00 **Activities of National Headquarters in Relation to Student Chapters**
E. S. Kirkpatrick, A.M. ASCE, Asst. to the Secretary, ASCE.

10:30 **Report to Faculty Advisers from the Committee on Student Chapters**
Emory E. Johnson, M. ASCE, Member, Committee on Student Chapters.

11:10 **Developing Professional Attitudes in Young Engineers**
Edwin H. Gaylord, Jr., M. ASCE, Member, Task Committee on Professional Development.

STUDENT PROGRAM

9:30 a.m. G. B. Shaw Room

Representatives from 44 Student Chapters have been invited to participate in a conference to discuss subjects of mutual interest.

Awards will be made for student papers.

FRIDAY ALL-DAY FIELD TRIP

Feb. 28

Dresden Nuclear Power Plant

Departure: 8:15 a.m. from Sherman Hotel by bus.

Return: 5:00 p.m. to Sherman Hotel by bus.

Fifty miles southwest of Chicago, one of the most exciting peacetime episodes of this atomic age is taking place. The largest all-nuclear plant under way in this country is now rising where the historic Kankakee and Des Plaines Rivers meet to become the busy Illinois River link in the Lakes-to-Gulf Waterway. Here the energy of the mysterious atom will be harnessed to add 180,000 kw to northern Illinois' expanding reservoir of electricity. The Dresden Station, which is a cooperative enterprise of the Nuclear Power Group, Inc., is to be completed and in service in 1960. Commonwealth Edison Company will own and operate the station.

Registration: At the Convention registration desk no later than 5:00 p.m., Wednesday, Feb. 26.

Notes: No cameras are allowed on this trip. Civil engineering aspects of the Dresden Nuclear Power Plant are discussed at the Construction Division's Tuesday afternoon session and the Power Division's Wednesday afternoon session. Structural aspects of nuclear reactor design are discussed at the Structural Division's Tuesday afternoon session.

FRIDAY MORNING FIELD TRIPS

Feb. 28

Portland Cement Assn. Labs., Skokie, Ill.

Departure: 8:30 a.m. from Sherman Hotel by bus.

Return: 12:00 noon to Sherman Hotel by bus.

The research and development facilities of the Portland Cement Association at Skokie, Ill., are the largest and the most completely equipped laboratories in the world devoted exclusively to research in cement and concrete.

Located about 20 miles north of Chicago's Loop, the Skokie Laboratories at present contain about 100,000 sq ft of floor space, initially occupied in 1949. The original cost of buildings and equipment was $3,000,000.

Expansions to plant and equipment are now under way at an additional cost of $2,750,000. These extensions, consisting of a structural laboratory and a fire research laboratory, will provide another 60,000 sq ft of floor space. Scheduled for occupancy in the first quarter of 1958, the new facilities will be devoted to work in the structural and fire research fields.

Cost: Round trip bus fare, $0.75.

Registration: At Convention registration desk not later than 5:00 p.m., Wednesday, Feb. 26.

Public Works Development in Chicago

Departure: 8:45 a.m. from Sherman Hotel by bus.

Return: 12:15 p.m. to Sherman Hotel by bus.

To inspect the following public works projects:

Central District Filtration Plant

This filtration plant, anticipated to cost some $90,000,000 when completed, will have a capacity of 960,000,000 gal per day and will provide filtered water for 3,000,000 people. It is being built in Lake Michigan just to the north of the Navy Pier in a site 61 acres in area, which was reclaimed from the bed of Lake Michigan by enclosing it with a dike, and later dewatering.

Congress Street Expressway

Congress Street Expressway is one of the most modern to be built anywhere in the United States. It extends from the Lake Front westward to the city limits, for a distance of 8 miles. An average of 84,437 vehicles used the superhighway each day during its first year. The facility when completed to the city limits will cost $100,000,000. It will incorporate a two-track rapid transit facility in the median strip between the two roadways, which will cost an additional $20,000,000.

Calumet Skyway Toll Bridge

This superhighway consists of a high-level fixed bridge over the Calumet River in the vicinity of 100th Street, together with approaches to the bridge from the southeast and northwest. The total length of the bridge and its approaches is approximately 7 miles. The project is about 80 percent finished, and is anticipated to be opened to traffic early in the summer of 1958. It will cost about $101,000,000 when completed.

City of Chicago Parking Facilities

In 1953 Chicago embarked on a $50,000,000 program financed from revenue bonds. To date 11 structures and more than 30 surface lots have been built at an expenditure of $30,000,000. A further phase of the program is under way including 5 deck structures and some 36 parking lots in outlying communities. Use was made of both ramp-type and hoist-type structures.

Short stops will be made at a few of these structures to illustrate the operation of the facilities.

Cost: Round-trip bus fare, $1.25

Registration: At Convention registration desk not later than 11:00 a.m., Thursday, Feb. 27.

Notes: The public works projects inspected on this trip are discussed at the Construction Division's Tuesday afternoon session, the City Planning and Highway Divisions' Wednesday afternoon joint session, the Sanitary Engineering Division's Thursday morning and afternoon sessions, and the Soil Mechanics and Foundations Division's Thursday afternoon session.

Northwestern Univ. Truss-Bridge Research Project

Departure: 8:00 a.m. from Sherman Hotel by bus.

Return: 11:30 a.m. to Sherman Hotel by bus.

A 100-ft truss bridge has recently been erected on the campus of Northwestern University in Evanston to permit structural research under controlled conditions. The structure is designed to simulate both railroad and highway bridge loadings.

The bridge rests on concrete caissons extending 80 ft to hardpan. Hydraulic cylinders of 150-ton capacity each are located at the truss panel points and are connected to reinforced concrete caissons also extending to hardpan. Deflections of the structure will be determined by an optical measurement system.

This research project is being sponsored by the Association of American Railroads, the Corps of Engineers, and the U. S. Bureau of Public Roads.

FRIDAY AFTERNOON FIELD TRIPS

Feb. 28

Cost: Round-trip bus fare, $1.25.

Registration: At Convention registration desk not later than 5:00 p. m. Wednesday, Feb. 26.

Northwestern Univ. Truss-Bridge Research Project

Departure: 1:15 p.m. from Sherman Hotel by bus.

Return: 4:45 p.m. to Sherman Hotel by bus.

See similar trip Friday morning for details.

Portland Cement Assoc. Labs., Skokie, Ill.

Departure: 1:00 p.m. from Sherman Hotel by bus.

Return: 4:30 p.m. to Sherman Hotel by bus.

See similar trip Friday morning for details.

Public Works Development in Chicago

Departure: 1:30 p.m. from Sherman Hotel by bus.

Return: 5:00 p.m. to Sherman Hotel by bus.

See similar trip Friday morning for details.

WOMEN'S PROGRAM

Monday, Feb. 24

Social Period, 9:00 to 11:00 a.m., Gold Coast Room.

Get Acquainted Party, in evening, with husbands.

Tuesday, Feb. 25

Social Period, 9:00 to 11:00 a.m., Gold Coast Room.

Luncheon at the Lake Shore Club, 1:00 p.m. Bus leaves Hotel Sherman at 12:30 p.m. Original character sketches by Harriot Allen, Northwestern University School of Drama.

Wednesday, Feb. 26

Social Period, 9:00 to 11:00 a.m., Gold Coast Room.

Luncheon with Husbands

Cocktail Party and Dinner Dance, in evening, with husbands.

Thursday, Feb. 27

Meet in Women's Headquarters, 8:45 a.m., Gold Coast Room.

Brunch on "Top of Rock," Prudential Building, 9:00 to 11:00 a.m.

Open House, 8:00 p.m., Skyline Terrace Room. Entertainment by Lillian Smith, Swedish Comedienne.

Friday, Feb. 28

Social Period, 9:00 to 11:00 a.m., Gold Coast Room.

FACULTY ADVISERS CONFERENCE

Friday Afternoon, Feb. 28

2:00 p.m. Room 107

Presiding: Emory E. Johnson, M. ASCE, Member, Committee on Student Chapters

2:00 **Student Chapter Operation, an open discussion of Student Chapter programs**

SESSIONS OF THE BOARD

The ASCE Board of Direction will be in session at the following times:

Monday, Feb. 24, 9:00 to 5:00
Tuesday, Feb. 25, 9:00 to 5:00

CONVENTION COMMITTEE

Frank W. Edwards, *General Chairman*
John A. Logan, *Vice Chairman*
H. F. Sommerschield, *Vice Chairman*
Ralph B. Peck, *Central Ill. Chairman*
Allen R. Boudinot, *Tri-City Chairman*
Louis A. Bacon, *General Secretary*

Finance Committee

A. L. R. Sanders, *Chairman;* Norman F. Brunkow, LeRoy H. Cather, Theodore W. Van Zelst, Clifford H. Westcott

Hotel Committee

Thomas K. Breitfuss, *Chairman*

Rooms Subcommittee

Paul H. Kaar, *Chairman;* James B. Thompson, Thomas W. Spilman

Facilities Subcommittee

Robert L. Hall, *Chairman;* Carlos G. Bell, Jr., E. I. Fiesenheiser

Program Committee

Robert B. Banks, *Chairman*

Technical Program Subcommittee

Eivind Hognestad, *Chairman;* Leonard A. Carlson, E. Montford Fucik, Walter E. Hanson, J. O. Osterberg, E. J. Ruble

Social Program Subcommittee

John Gnaedinger, *Chairman;* Kenneth L. DeBlois, Robert B. Mack, Edward Mangotich, Charles H. Welker

Tours Subcommittee

Seng-Lip Lee, *Chairman;* Kenneth F. Lehmann, J. E. Linden, George I. Uitti, Dick Van Gorp

Public Relations

John G. Duba, *Chairman*

Attendance Subcommittee

James C. Fitch, *Chairman;* R. Dean Collins, Robert F. Erickson, Jr., William J. Hall, William T. Hooper, Jr., Bruce M. Johnson, Harold L. Koenig

Publicity Subcommittee

Albert L. Tholin, *Chairman;* Jessee R. Anderson, Jr., Edward E. Bauer, August P. Rinell, Paul C. Sandy, John W. Weber

Civic Clubs Subcommittee

Robert L. Kennedy, *Chairman;* William J. Bauer, John Slattery

Reception Committee

Virgil E. Gunlock, *Chairman;* Murray Blanchard, Ellis Danner, Wilford W. DeBerard, J. R. Gardner, F. G. Gordon, Cecil J. McLean, Carl A. Metz, Thomas M. Niles, L. S. Pappmeier, Howard F. Peckworth, John F. Seifried

Registration Committee

Raymond S. Knapp, *Chairman;* Donald C. Davis, John L. Donoghue, John G. Hendrickson, Jr., Orlando W. Irwin, Barry M. Kostenko, Walter D. Linzing, Charles F. MacNish, William H. Munse, Jr., George S. Salter, Chester P. Siess, James R. Swanson

Student Activities Committee

Benjamin A. Wasil, *Chairman;* Edward H. Coe, Edwin H. Gaylord, Jr., Wallis S. Hamilton, Richard W. Heil, Paul E. Langdon, John C. Seeger, Jr., Fred T. Wiesinger

Women's Program

Mrs. Virgil E. Gunlock, *Chairman;* Mrs. Robert B. Banks, Mrs. Thomas K. Breitfuss, Mrs. John G. Duba, Mrs. Frank W. Edwards, Mrs. William J. Edwards, Mrs. E. Montford Fucik, Mrs. L. R. Howson, Mrs. John A. Logan, Mrs. Carl A. Metz, Mrs. William H. Munse, Mrs. Cecil J. McLean, Mrs. L. S. Pappmeier, Mrs. Howard F. Peckworth, Mrs. A. L. R. Sanders, Mrs. Chester P. Siess, Mrs. H. F. Sommerschield, Mrs. Theodore Van Zelst, Mrs. Charles H. Welker

SOCIETY NEWS

Fund Raising for United Engineering Center Starts

With a pre-kick-off total of over a million dollars reported, the fund-raising campaign for the United Engineering Center is under way. Dr. Mervin J. Kelly, general chairman of the industrial campaign, made this encouraging announcement to over a hundred presidents and chairmen of the boards of the nation's leading industries and businesses gathered at a dinner at the Waldorf-Astoria on November 21. He told the group that it has a special obligation to handle the giving at the top level of management.

Ralph J. Cordiner, president of General Electric, stated that one out of every eight of his company's employees is a technical graduate; that the $5 million set up as industry's share is wise and proper; and that his company will do more than its share. "I consider it a duty to speak in favor of the center," stated Alfred P. Sloane, Jr., former chairman of the Board of General Motors, but he warned, "Make the building big enough." Pointing out that the Sputniks already had expressed his personal views, Donald A. Quarles, Deputy Secretary of Defense, stated that the Pentagon views the Engineering Center as important to the welfare of our country. Dr. James R. Killian, Jr., until a few weeks ago president of MIT, and now at the White House as coordinator of the nation's missiles program, added his enthusiastic endorsement to the Center which he characterized as a practical and bold move. Former President Herbert Hoover's "sermon" to the industrialists is reproduced in its entirety as an article in this issue. It is good reading for all of us.

Facilities for 22 Engineering Organizations

The site for the Center, the entire block front between 47th and 48th Streets, on the west side of United Nations Plaza, has been purchased for $2,700,000, and title to the last parcel of 3,500 sq. ft will be taken July 1, 1958. During the early part of 1957 space planning was started with the five Founder Societies—the American Institute of Chemical Engineers has become a Founder Society—and with the following 17 associates of the United Engineering Center:

- American Institute of Industrial Engineers, Inc.
- American Rocket Society, Inc.
- American Institute of Consulting Engineers
- The American Society of Refrigerating Engineers
- The American Water Works Association
- The Society of Naval Architects and Marine Engineers
- Illuminating Engineering Society
- American Society of Heating and Air-Conditioning Engineers, Inc.
- The Electrochemical Society, Inc.
- American Welding Society, Inc.
- Society of Motion Picture & Television Engineers
- Welding Research Council
- Engineers Council for Professional Development
- Engineers Joint Council
- Engineering Index, Inc.
- American Standards Association
- The Municipal Engineers of the City of New York

The combined membership in these societies reaches 250,000.

Studies to date indicate an immediate need for about three times the usable space currently available in the Engineering Societies Building. As visualized now, the building will be a twenty-story air-conditioned tower superimposed on lower structures with landscaped surroundings. In addition to facilities for performing present functions, there will be space for engineering meetings, dining rooms, a cafeteria, enlarged library and publication functions; space for exhibits that will interpret engineering to the general public; and an Engineering Hall of Fame. These requirements indicate a need for about 188,000 sq ft of

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Chairman E. R. Needles, of ASCE Member Giving Program, displays architectural model of twenty-story United Engineering Center. Extension of tower to the right is contemplated when growth requires more space.

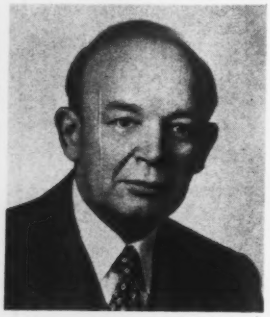
usable space, plus an additional 59,000 sq ft for elevators, mechanical equipment, and hallways—a total area of about 250,000 sq ft. Until bids are received no one can say for sure what the cost of the building will be, but it is expected that the cost will not exceed $30 per sq ft, that is, about $7.5 million. With the cost of the land added, the total becomes about $10 million, which is the goal of the fund-raising campaign.

Present assets of UET, Inc., earmarked for real estate purposes and estimated proceeds from the sale of the present building and site, will provide $2 million. From the members of the societies, $3 million is expected, and from industry and business, $5 million more.

Charles F. Kettering, Hon. M. ASCE, has accepted the post of honorary chairman of the Member Giving Program, which will be conducted on a voluntary basis. Associated with him are, Richard E. Dougherty, general chairman; Enoch R. Needles, ASCE chairman; August B. Kinzel, AIME chairman; William F. Ryan, ASME chairman; Lester Goldsmith, AIEE chairman; and S. R. Kirkpatrick, AIChE chairman. Quotas have been set for each society, based on their membership and dues receipts, with ASCE's share put at $800,000. Each society's Member Giving Committee is working out a program that will be best suited to the particular needs of that society. It is anticipated that the associate societies also will join in the member-giving campaign.

Research Prizes to Be Presented at Chicago Convention

One of the pleasant features of the Chicago Convention will be the presentation, at one of the luncheon meetings, of the Society's 1957 Research Prizes. The three prizes, each consisting of $100 and an appropriate Certificate of Award, will go to Mikael J. Hvorslev, consultant to the Soils Division of the Waterways Experiment Station at Vicksburg, Miss.; Bruce G. Johnston, professor of civil engineering at the University of Michigan; and Lorenz G. Straub, head of the civil engineering department at the University of Minnesota. All are members of ASCE.



M. J. Hvorslev

Dr. Hvorslev has been at the Waterways Experiment Station since 1946, serving as consultant on soil mechanics and foundation problems in the United States, Panama, Alaska, and Greenland. Prior to 1946, he was a research fellow at Harvard University, and research engineer for the ASCE Soil Mechanics and Foundations Division on the preparation of a 520-page volume that was distributed by Engineering Foundation. Earlier he visited European hydraulic laboratories; did research in Austria and Denmark; and for twelve years (1921 to 1933) worked on the design and construction of dams and hydroelectric and water supply projects on the Pacific Coast and in Colombia. A native of Denmark, he has been a U.S. citizen since 1929. He graduated from the Danish Institute of Technology in 1918, and received his doctorate in technology from the Vienna Institute of Technology in 1936.

Dr. Johnston is currently on a year's leave of absence from the University of Michigan, where he has been professor of civil engineering since 1950. While on leave he has an office at the University of Florida, where he is lecturing part time and also working on the preparation of a "Guide to Column Design Specifications" for Column Research Council, of which he is chairman. Before going to the University of Michigan, Dr. Johnston was for some years director of the Fritz Engineering Laboratory at Lehigh University. He received his early engineering training at the University of Illinois, and later did graduate and research work at Lehigh and at Columbia University. He has twice received the J. James R. Croes Medal for his investigations in the field of torsion—initially with Inge Lyse and twenty years later for work carried out with Dr. F. A. Chang. He has acted as consultant to various governmental agencies, including the Federal Civil Defense Administration, in the field of analysis and design of shock loaded structures.

Dr. Straub is professor and head of the department of civil engineering at the University of Minnesota and, also, director of the St. Anthony Falls Hydraulic Laboratory, which he originally planned and generally supervised in design and construction, 1936-1939. He holds four degrees from the University of Illinois, receiving his Ph.D. in structural engineering in 1927. As first of the Society's Traveling Fellows, he spent two years (1927-1929) at various technical universities, particularly in Germany, and visited notable hydraulic engineering works abroad. His earlier professional work included positions as design engineer for the Burns and McDonnell Engineering Company; hydraulic engineer for the Corps of Engineers; and a number of different academic and administrative positions at the University of Minnesota. He has been on leave from the university at various times on special scientific undertakings and on major hydraulic engineering projects. During the war years he was attached to the National Defense Research Council to coordinate scientific research and development work on undersea warfare ordnance and rocket weapons, for which he received Army and Navy commendation. He is past-president of the International Association for Hydraulic Research.

Bruce Johnston

Lorenz Straub

Participation in Mead Prize Competition Urged

By means of a circular letter recently sent to the secretaries of all Local Sections and Branches, Junior Members are being reminded that a new Mead Prize Competition is open. This year's topic—"What Procedures Can Be Used in Negotiating for Engineering Services to Eliminate Competition on a Price Basis"—is especially timely in view of the Society's interest in eliminating the selection of engineers solely on the basis of price. The views of younger members on the subject are eagerly sought.

In addition to the satisfaction of contributing to a subject of interest to the entire profession, the winner will receive a cash prize of $100 and an engraved certificate. The rules are simple. Papers must not exceed 2,000 words, and to be eligible for entry in the contest they must be presented at some Local Section meeting. Only one paper—the best naturally—from each Section can be entered in the final contest. Each Section's entry must be in the hands of the Executive Secretary of ASCE before May 1, 1958.

A new Daniel W. Mead Prize for Students, to be handled through the Student Chapters, is also open. This year the student topic is "Ethical Aspects of Current Practices in the Recruitment of Graduating Engineers." The prize consists of $50 in cash and an engraved certificate. Final entries are also due at Society headquarters by May 1.

Full details of both awards are carried in the 1958 Official Register, which will soon be mailed to members.

ASCE Manual on Sewers in Review

In cooperation with the Federation of Sewage and Industrial Wastes Associations, a committee of the ASCE Sanitary Engineering Division has been working for several years to produce a Manual on the Design and Construction of Sanitary and Storm Sewers. Some idea of its content and scope may be gained from the chapter headings: (1) Organization and Administration of Sewer Projects; (2) Surveys and Investigations; (3) Quantity of Sanitary Sewage; (4) Quantity of Storm Water; (5) Hydraulics of Sewers; (6) Design of Sewer System; (7) Appurtenances and Special Structures; (8) Materials for Sewer Construction; (9) Structural Requirements; (10) Construction Plans and Specifications; (11) Construction Methods; and (12) Sewage and Storm Water Pumping Stations.

A limited number of committee manuscripts are now available for review by the Society members, as a prerequisite to its final acceptance and production. This preliminary copy may be borrowed for a period not exceeding two weeks, the Society paying all postal charges. The manual is not authorized for use in general practice, but it is sincerely hoped that members with a professional interest in maintaining the standards of the Manuals of Engineering Practice will volunteer to examine it and record their opinion of it. The Board of Direction needs such a record before its final clearance of the manual. Comments may be mailed to the Committee on Preparation of a Manual of Practice on Sanitary and Storm Sewer Design and Construction, at ASCE headquarters, until March 15, 1958.

For the past thirty years ASCE has been issuing Manuals of Engineering Practice. Attesting to the care and deliberation that go into each of these manuals is the fact that only thirty-five of them have been approved in the entire thirty years.

J. Waldo Smith Hydraulic Fellowship Is Available

Student Chapter members wishing to continue their studies in hydraulics may want to take advantage of the J. Waldo Smith Hydraulic Fellowship for the 1958-1959 school year, which was announced by the Board of Direction at the Annual Convention in October. The fellowship carries a cash stipend of $1,500, payable October 1, plus such additional funds (to a total of $2,000) as may be required for physical equipment connected with the research.

It should be remembered that the scope of the fellowship is restricted to research in the field of experimental hydraulics as distinguished from purely "theoretical hydraulics." This means that emphasis is to be placed on practical experiments for the purpose of advancing knowledge of the laws of hydraulic flow, rather than on "the type of research which proceeds on the theory of mathematical analysis based on assumptions of unknown validity." In other words, the purpose of the research is to test current assumptions and to develop a better understanding of fluid flow.

Applicants for the J. Waldo Smith Fellowship must be less than 30 years old and, preferably, Junior Members of the Society. They should include copies in triplicate of a summary of their training, experience, and personal data, together with a recent photo and an outline of the proposed research project; three copies of a letter from the department head appraising their qualifications for the project; a transcript of their academic record; and a letter from a dean or similar officer certifying that the applicant is eligible for full-time graduate study and that the proposed project has administrative approval.

Applications are to be submitted through the appropriate faculty officer, who will submit them to the Executive Secretary.

Otis Gouty Joins ASCE Headquarters Staff

Otis D. Gouty, J.M. ASCE, former engineer with the Central States Pipe Lines Division of the Socony Mobil Oil Co., at Wichita, Kans., has joined the ASCE headquarters staff in New York City as Assistant to the Secretary. A native of Kansas City, Mo., Mr. Gouty was graduated from the University of Kansas in June 1957 with a B.S.C.E. degree. Active in Student Chapter work, he received the Kansas Section's annual award for outstanding senior. He was also elected to Sigma Tau and Tau Beta Pi, national honorary engineering fraternities. He served in the U. S. Air Force during the Korean War before entering college.

Otis D. Gouty

In his work for the Society Mr. Gouty will be primarily concerned with the Student Chapters and Local Sections. His home is in suburban Yonkers, N. Y.

Kansas City Section Is Host to Large Highway Conference

Highway officials from fifteen states and others interested in the nation-wide highway program heard many phases of freeway development discussed at a timely and ambitious highway conference sponsored by the Kansas City Section. The conference, which took place in Kansas City on November 7 and 8, was attended by more than 600.

Many of the talks covered recent progress and developments in freeway construction. Others emphasized the need for public education in carrying out the highway program. Prominent among the speakers in the latter category was Maj. Gen. Louis W. Prentiss (ret.), executive vice-president of the American Road Builders Association. General Prentiss urged an educational program to convince persons bypassed by the new highways that their towns will not "wither and die on the vine."

"Limited access bypasses," General Prentiss said, "have invariably rejuvenated the bypassed town, cured its disease of traffic paralysis, opened the streets to people who want to be in the town—not passing through it—and have brought the merchants greater prosperity by facilitating shopping in the local stores." He also said that the new system of highways means reduced vehicle-operating costs, new jobs, better national defense, and growth of both residential and industrial areas.

W. A. Bugge, director of highways for the state of Washington and president of the American Association of State Highway Officials, appealed to the engineers to take the lead in support of the highway program and of the highway departments that are carrying out the program. Otherwise, he said, the federal government could dominate the road picture, and instead of the program's being a "cooperative project of the states and federal government, it would be a highway program dominated by a single central agency." The best way to strengthen the highway departments, he advised, is to build them up with outstanding personnel so that they can do the job the people want them to do.

The problem of right-of-way acquisition in the highway program was discussed by Robert L. Hyder, chief counsel for the Missouri State Highway Commission, in a paper read by G. P. Hayes, of Mr. Hyder's office. One of the major problems, according to Mr. Hyder, is to prevent speculation and profiteering in the sale of right-of-way land. "In all cases where there has been an exchange of property within the past year," he said, "we make a special investigation to determine whether or not the sale is bona fide or whether there is an attempt at speculation involved."

Among others taking part in the conference were Philip E. Geissal, chief planning engineer for Kansas City; Darel L. Trueblood, regional planning engineer for the Bureau of Public Roads at Kansas City; George T. Mahoney, chief planning engineer for Howard, Needles, Tammen & Bergendoff; W. W. Fryhofer, regional design engineer for the Bureau of Public Roads, Robert H. Sheik, engineer for the Ohio Department of Highways; S. E. Ridge of the Bureau of Public Roads, Washington; Frank E. Bleistein, office engineer for Howard, Needles, Tammen & Bergendoff; R. L. Peyton, research engineer for the Kansas State Highway Department; Harold E. Olson, engineer of roadside development for the Minnesota Highway Department, St. Paul; and Glenn C. Richards, commissioner of the Department of Public Works, Detroit, Mich.

Battery of distinguished speakers addressing Kansas City Section's Highway Conference includes (left to right) Frank E. Bleistein, office engineer for Howard, Needles, Tammen & Bergendoff, Kansas City; G. P. Hayes, assistant to chief counsel, Missouri State Highway Department; Glenn C. Richards, commissioner of the Department of Public Works, Detroit, Mich.; Harold E. Olson, Minnesota State Highway Department; and R. L. Peyton, research engineer for the Kansas State Highway Department.

Translations from Russian Available

Since the advent of Sputnik the translation department of the Engineering Societies Library has noted a substantial increase in inquiries from American engineers and firms interested in translations of Russian technical publications. Today more and more translations of Russian technical and scientific material—particularly some of the more recent publications—are becoming available. The Library directs inquiries to the appropriate man or organization from whom existing translations are obtainable. When no existing translation of a particular technical item can be found, the Library will, on order, translate it correctly into idiomatic English.

There is also increasing demand for more up-to-date abstracting and indexing of original Russian technical and engineering information not necessarily translated as yet. The Engineering Index Service, which indexes the engineering publications received by the Engineering Societies Library, is expanding its coverage of Russian publications. In contrast to the period immediately following World War II, the Russians are making their technical publications much more readily available. They have expressed great interest in the Engineering Societies Library in enlarging existing exchange arrangements, whereby the Library sends them the publications of its four Founder Societies for equivalent Russian material. This exchange is of great benefit to America, and will be further developed.

Inquiries may be directed to Ralph H. Phelps, Director, Engineering Societies Library, 33 West 39th Street, New York 18, N. Y.

Tennessee Valley Section Has Ambitious Annual Meeting

Albert S. Fry, wise in the ways of Society programs, has been widely praised for the success of the Tennessee Valley Section's annual meeting, of which he was chairman. The other members of the general committee were Dr. E. S. Fabian, co-chairman, and James Smallwood and Charles Durfee. Held at Knoxville on November 15 and 16, the meeting proved a venture in big-time programming that actually paid off. The total attendance of 350 represented some 40 percent of the Section's assigned membership, in contrast to the 3 percent of the total membership now attending Society Conventions.

From ASCE President Louis R. Howson, honor guest and featured speaker at the Friday luncheon, on down to a new member of ASCE, it was the consensus that it "was the kind of meeting that draws young engineers." At least five engineers, not members of the Society, came to hear papers that interested them. And there were many others, some not even engineers, who were attracted by the exceptional publicity that Edward Nowakowski and his committee obtained for the meeting in the press and on TV.

Running concurrently all Friday afternoon were six three-hour technical group sessions offering 28 speakers and two films. Presiding over five of the sessions were the following University of Tennesse civil engineering professors: Charles R. Walker, structural session; Harry H. Ambrose, hydraulics; E. Clark Shreve, highways; Floyd C. Larsen, sanitary; and Henry B. Aikin, surveying and mapping. Each of these chairmen was responsible for developing the program for his assigned technical session, and each did a fine job. The sixth session—in the important field of city planning—was arranged by Harry B. Tour, of the staff of the TVA and a member of the Knoxville-Knox County Metropolitan Planning Commission, who also presided. Something new in Tennessee Valley Section programs was a student paper competition, with five students represented in four of the sessions and one graduate student in another session.

The buffet-style banquet on Friday evening featured a talk by Eugene F. Bespalow, vice-president and chief engineer of the Choctaw Culvert and Machinery Company, of Memphis. Mr. Bespalow, who is famous for the photographs he has taken on business and pleasure trips all over the world, held an enthralled audience with his beautiful slides and descriptive commentary. Joseph B. Kingsolver was presented with a Life Membership certificate by G. O. Wessenauer. He has been with the TVA since 1934.

Some fifty stalwarts braved heavy rain on Saturday to take advantage of the inspection tours that had been arranged. The morning got off to a good start with a breakfast, at which C. S. Craven, professor of physics at the University of Tennessee, explained what makes the Sputniks go. The interesting tour took in the laboratories and engineering facilities on the University of Tennessee campus, the Armory-Field House and the new Knoxville sewage disposal plant. At the armory, which is under construction, Dewey Tucker, of the Tucker Steel Co., described the fabrication and erection of the giant roof trusses, and John Neely explained the provisions for future expansion.

Prominent on the program for the Tennessee Valley Section's annual meeting were (front row) Chairman Albert S. Fry, chief of the Hydraulic Data Branch of the TVA; ASCE President Louis R. Howson; Don H. Mattern, ASCE Director for District 10 and chief of the Project Planning Branch of the TVA; and George K. Leonard, chief engineer of the TVA. In back row are Section President Henry C. Peeples; Robert A. Monroe, chief design engineer for the TVA; Henry T. Lofft, chief construction engineer for the TVA; Burgress B. Brier, civil engineer in the Office of the Chief Engineer, TVA; and John L. Neely, president of the Knoxville Branch.

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Winners in the student prize paper competition are (in usual order) Horace Beckner, William T. Medley, Joseph P. Thomas, and Frank D. Stansberry. ASCE Contact Member Franklin Pitcher (at far right) made the awards during the Friday banquet.

ASCE QUARTERLY ENGINEERING SALARY INDEX

Consulting Firms

City	Current	Last Quarter
Atlanta	1.11	1.11
Baltimore	1.11	1.10
Boston	1.13	1.13
Chicago	1.26	1.12
Denver	1.19	1.14
Houston	1.08	1.08
Kansas City	1.14	1.11
Los Angeles	1.16	1.16
New York	1.17	1.17
Pittsburgh	0.93	0.91
Portland	1.15	1.15
San Francisco	1.18	1.21
Seattle	1.07	1.07

Highway Departments

Region	Current	Last Quarter
I, New England	0.88	0.88
II, Mid. Atlantic	1.15	1.12
III, Mid. West	1.24	1.19
IV, South	1.02	1.05
V, West	0.96	0.96
VI, Far West	1.15	1.12

Figures are based on salaries in effect as of Nov. 15, 1957. Base figure, the sum of Federal Civil Service, G. S. Grades 5, 7, and 9 for 1956, is $15,930.

ASCE Membership as of December 9, 1957

Members	9,777
Associate Members	13,255
Junior Members	17,775
Affiliates	77
Honorary Members	46
Total	40,930
(Dec. 10, 1956	39,715)

EJC Survey Available

In 1957 there was a slight reduction from the previous year in the overall demand for engineer (14.3 percent in 1956 to 12.1 percent in 1957). This is one of the findings of a recent survey of the 1957 demand for engineers conducted by the Engineering Manpower Commission of Engineers Joint Council and released in its Report No. 108. The report also shows that the upward trend in accessions (hires minus losses) was not maintained.

Since 1951 EJC has conducted annual studies to determine trends in the demand for engineering graduates. The present survey—Part I—includes responses from industrial firms and government agencies contacted through a list organized and maintained by the EMC. Data collected from a special sampling will be reported in Part II at a later date. Part I sells for $1.00, and is available from EJC at 29 West 39th Street, New York 18, N. Y.

NOTES FROM THE LOCAL SECTIONS

(Copy for these columns must be received by the fifth of the month preceding date of publication)

The **Akron Section** honored its new life members—F. W. Stafford, A. R. Seese, Jr., and M. S. Raudebaugh, Sr.—at a recent meeting. The featured talk dealt with the manufacture of grinding wheels and other products of the Carborundum Company of Niagara Falls. Featured speaker was Don Foot, on the staff of the company.

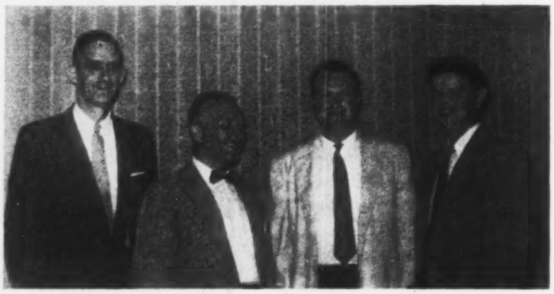
Slated to head the **Juneau Branch** of the **Alaska Section** for the coming year are Felix J. Toner, president; R. J. DeLaHunt, vice-president; and B. V. Chatfield, secretary-treasurer.

Members of the **Arizona Section** have proved that they can mix business and pleasure. The occasion was the Section's annual fall meeting, held in Phoenix November 15-16, with over 230 engineers present. Garvin Dyer, president of the National Society of Professional Engineers, started the meeting with a talk on the current aims of the society. Krafft A. Ehricke, assistant to the Technical Director of Convair Astronautics, San Diego, Calif., supplied adventure and excitement by describing "The Exploration of Space by Means of Artificial Comets." At a joint luncheon with the American Association of Engineers on Saturday, three members—James S. Mills, Charles Cavan, and Sid Smyth—were awarded life membership certificates. After Saturday business meetings, members and guests gathered for a western-style Bar-B-Que and dance, which was a huge success. The Section will be headed by Clarence H. Whalin in the coming year.

An interesting and varied agenda drew a large crowd to the recent **Cleveland Section** meeting. Coffee speaker was Dr. Edmund H. Chapman, chairman of the Division of Art and Architecture at Western Reserve University, who accompanied his color slides of modern buildings in Mexico and the southwestern United States with a running commentary on trends in contemporary architecture. He was followed by Bruce A. Lamberton, manager of research and development for the Intrusion Prepakt Company, who discussed various methods of placing high density concrete for atomic shielding.

New officials of the **Duluth Section** are Robert H. Fredstrom, president; John T. Adams, first vice-president; Leo H. Ebert, second vice-president; Walter Spannaus, secretary; and Carl A. Sivertson, treasurer.

Unlike previous summers, the **Hawaii Section** held a series of outdoor programs this year. There were field trips to the Ewa Sugar Plantation, the Hawaii Marine Laboratory on Coconut Island, and the Wilson Tunnel. A gay family picnic was also held. Featured speaker at a recent meeting was Robert Y. Hudson, chief of the Wave Action Section of the Waterways Experiment Station at Vicksburg, Miss. Mr. Hudson, who was on a tour of duty in connection with the design of breakwaters at Kahului, Maui, and Nawiliwili, Kauai, spoke on "Laboratory Investigations of Rubble-Mound Breakwaters."



East Coast Branch of Florida Section, newest ASCE Branch, is off to a good start at first meeting. Its officers are H. B. Wright, vice-president; Hubert McDonell, president, Florida Section; W. A. Bellisle, president; and W. D. Heasley, secretary-treasurer.

A universal problem—city traffic—was discussed at a recent **Intermountain Section** meeting by James Challis. Mr. Challis, Salt Lake City traffic engineer, examined the problems and progress of his department.

The **Kansas Section** recently heard Dr. John S. McNown, dean of the School of Engineering at the University of Kansas and current chairman of ASCE's Engineering Mechanics Division, present an informative discussion of the functions and scope of the Division, and the importance of engineering mechanics to other branches of civil engineering. The program was concluded by a question period.

Design features of the second deck of the George Washington Bridge were described by Irvine P. Gould, engineer of design for the Port of New York Authority, at the **Lehigh Valley Section's** November meeting. Difficulties encountered in designing the approaches for the lower deck are caused primarily by a lack of space for access ramps and toll plazas, due to existing buildings. The complete cost of the project with approaches (the costly feature) will be about $185,000,000.

At the helm of the **Junior Member Forum** of the **Los Angeles Section** for 1958 are Louis R. Hovater, president; Robert F. Clawson, first vice-president; Rodney P. Lundin, second vice-president; James D. Reiter, secretary; and Thomas L. Drum, treasurer. New officers of the **Santa-Barbara-Ventura Counties Branch** are Sterling Bugg, president, and George Conahey, secretary-treasurer.

An open house and dinner started the festivities at the annual meeting of the **Maine Section's Vermont Branch.** An illustrated talk on "Modern Trends in Steel Construction," given by T. R. Higgins, director of research and engineering for the American Institute of Steel Construction, topped off the evening.

A highlight of the **Maryland Section's** November meeting was the presentation of life membership certificates to eight distinguished members. Honored were Walter P. Bloecher, Albert C. Dunn, George L. Hall, John C. Heller, Paul L. Holland, Ralph K. Linville, Albert W. Paine, and John F. Remley. Featured speaker at the interesting meeting was Charles A. Bowser, assistant commissioner for technical standards, Federal Housing Administration, who explained the purposes and recent activities of the organization, with emphasis on the engineer's role.

New Columbia Section officers are (in usual order) Niel F. Meadowcroft, director; Edgar R. Smith, first vice-president; Allan T. Gifford, president; E. C. Franzen, past-president; and Charles H. Henager, secretary-treasurer. Vice-president Bertram W. Hoare was absent when photo was taken.

The **Miami Section** played host to Executive Secretary William H. Wisely at its November meeting. Mr. Wisely spoke on the "Current Aims and Functions of the Society." Stressing that the purpose of the Society is to serve its members, he described the numerous ways in which better service is being made available.

The roster of new **Mid-South Section** officers is as follows: Harold J. Engstrom, president; J. Irby Seay, vice-president; and Earl C. Meserve, secretary-treasurer. The **Memphis Branch** recently heard an interesting talk on the planning and development of the Kitimat Project of the Aluminum Company of Canada, by McNeely DuBose. The speech was followed by a sound movie of the entire project. New Branch officers are O. L. Pickering, president; F. G. Van Brocklin, vice-president; and R. E. Hagenhoff, secretary-treasurer. An energetic discussion of ASCE policies relating to professional welfare dominated a recent **Vicksburg Branch** meeting. E. P. Fortson, Jr., past-president of the Branch and head of a committee investigating the matter, reported three conflicting views on the adequacy of ASCE action. An open debate followed his talk.

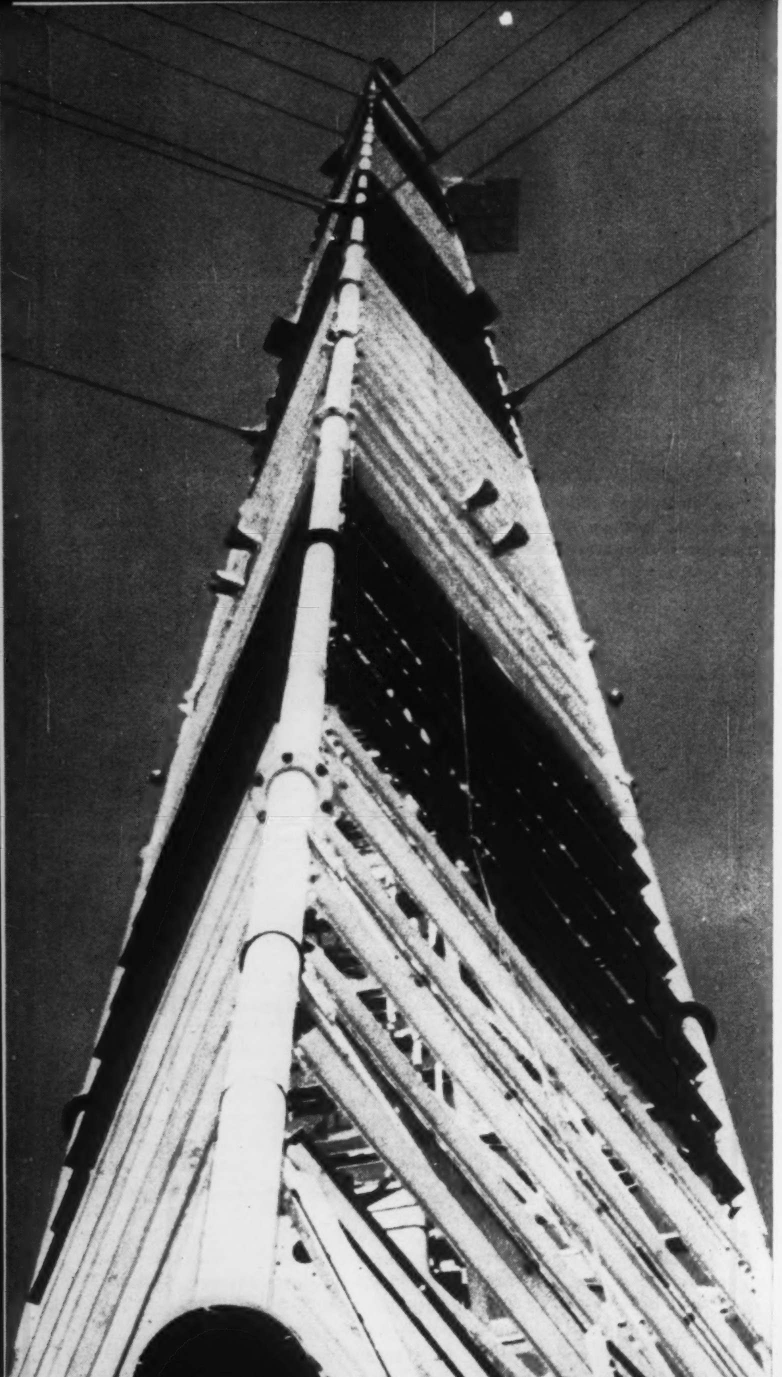
The **Billings Branch** of the Montana Section recently heard an enlightening talk on the "Progress of the Interstate Highway Program in Montana." Featured speaker was Paul Johnson, district engineer for the Montana State Highway Commission.

Top performer at a recent **Nashville Section** meeting was an electronic brain whose antics and accomplishments were applauded by members. The brain, lent for the evening by the Life & Casualty Insurance Company of Nashville, proved a valuable helper in solving engineering problems. The brains behind the Section for the coming year will be J. Sanders Parker, president; Edward M. Dougherty, vice-president; Lloyd C. Smith, secretary-treasurer; and Dan Barge, Jr., and Donald A. du Plantier, directors.

The old and the new were studied at a recent **National Capital Section** meeting, when William R. Ganser of the American Institute of Timber Construction spoke on "Wood Rediscovered." Mr. Ganser gave a short survey of wood use during the past seventy centuries, and discussed some of the new techniques and processes which have made it again a valuable construction material. Annual Section awards were presented to two outstanding Student Chapter members of the area—Richard A. Haefs, of George Washington University, and Bernard P. Jenkins, of Howard University.

The technical and legal problems involved in water resource development and conservation were discussed at the **Northwestern Section's** November meeting by Adolf Meyer, consulting hydraulic engineer. Following his talk, Mr. Meyer answered the questions raised by his analysis.

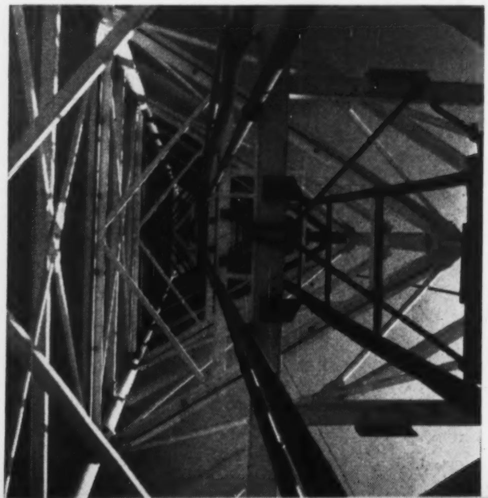
The spotlight was on prestressed concrete at a recent joint meeting of the **Pittsburgh Section** and the Civil Section of the Engineers' Society of Western Pennsylvania. A panel discussion on developments in the field was presented by



USS cuts

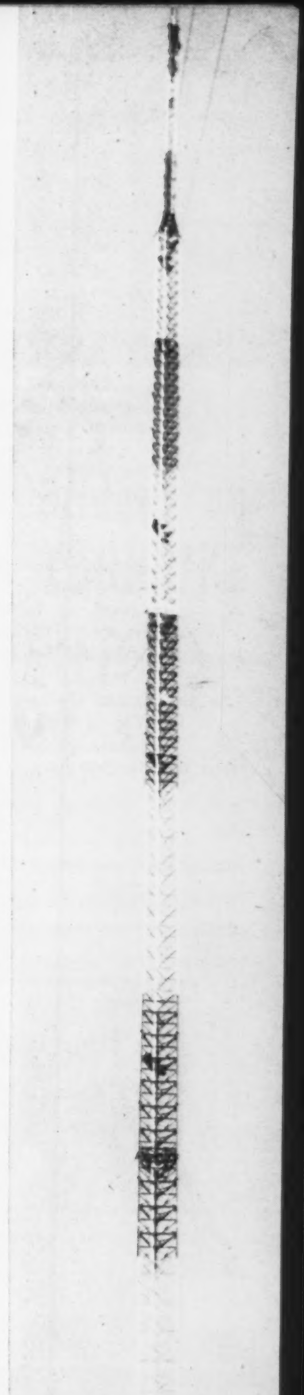
3,000,000 pounds of pressure are concentrated at the tower base. This includes the weight of the tower and guy lines plus the downward pull of the guy lines. USS "T-1" Steel, used in the solid bar legs, carries this load.

44% smaller legs were possible because of the great strength of USS "T-1" Steel. Cost reduction: 15%.



"T-1" Steel cost 15%

in 1,199-foot TV Tower



THIS is the new 1,199-ft. WBZ-TV transmitting tower near Boston, Massachusetts. It's unique because up to the 838-ft. level its legs are of USS "T-1" Steel, a constructional alloy steel so strong it made possible significant savings for the tower owner. This structure was designed and built by Dresser-Ideco for Westinghouse Broadcasting Co.

WBZ's tower presently supports a 6-bay channel 4 antenna, but future plans call for it to carry plenty of additional weight; pending FCC approval, another 300 feet of height will bring it to an ultimate 1,499 feet. The tower had to be built with the strength to accommodate this extra weight without the necessity of future structural modifications.

Round, hot-rolled, heat-treated bars of USS "T-1" Steel were used for the three legs up to the 838-ft. height because this alloy steel has nearly three times the yield strength of structural carbon steel. It therefore enabled Dresser-Ideco to reduce the size of the legs greatly, lowering shipping weight, welding costs, wind stresses and over-all weight and price. For example, consider the leg members at the bottom of the tower. Cross-sectional area of these "T-1" bars is only 56% of the area required with the usual structural carbon steel, resulting in a 44% material savings. Also saved: the cost of hot forging and machining, since carbon bars of the size required for the biggest members are too large to be produced economically by hot-rolling. *Altogether, the builders estimate that "T-1" Steel cut the cost of this tower by 15%.*

• • •

For more information on USS "T-1" Constructional Alloy Steel, contact any office of United States Steel (listed in all phone directories), or write United States Steel, 525 William Penn Place, Pittsburgh 30, Pa. For details about the column strength of "T-1", write us for our booklet on the subject.

United States Steel Corporation, Pittsburgh · Columbia-Geneva Steel Division, San Francisco
Tennessee Coal & Iron Division, Fairfield, Ala.
United States Steel Supply Division, Warehouse Distributors, Coast-To-Coast
United States Steel Export Company, New York

USS "T-1" CONSTRUCTIONAL ALLOY STEEL

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USS

UNITED STATES STEEL

Charles A. Keelen, structural engineer with the Portland Cement Association; Earl A. Butts, engineer for the Dickerson Structural Concrete Corp.; and John F. Heinzerling, engineer for Richardson, Gordon and Associates. The three speakers, covering the design, manufacture, and construction and testing of prestressed concrete products, led a thought-provoking discussion.

Kingsley Woodworth, of the Boston Division of the Corps of Engineers, was guest speaker at a recent **Rhode Island Section** meeting. Mr. Woodworth's talk on the "Garrison Dam and Reservoir" was illustrated with movies and slides.

The **South Carolina Section,** at a joint meeting with The Citadel Student Chapter, heard an interesting and informative paper. The author, Cadet Henry H. Mathews, developed the subject of the remedial measures taken to strengthen the concrete beams supporting the roof structures on the AMC warehouses at the Robbins Air Force Base in Georgia.

A film, a brisk talk, and some rapid questions and answers were on the agenda of the recent joint meeting of the **St. Louis Section** and the Engineers' Club of St. Louis. Speaker of the evening was G. A. Fletcher, assistant vice-president of the Raymond Concrete Pile Company, who discussed the engineering problems encountered in the construction of the Texas Towers.

A tri-partite survey of the highway situation was featured at a recent **Toledo Section** meeting. Moderator of the evening was F. C. Miller, of Sanzenbacher, Miller and Brigham, sponsors of the program. Speakers were F. J. Murray and W. A. Martin, of the Ohio Highway Department, who spoke on "The 1957 Toledo Metropolitan Traffic Survey;" E. D. Shinavar, who discussed "Interstate Road Design Practice;" and B. J. Harbaugh, who spoke on "Today's Trends in Bridge Design." A vigorous discussion concluded the program.

Civil engineering problems involved in industrial expansion were discussed by Joe Foley, assistant chief engineer for the Kimberly-Clark Corporation, Neenah, Wis., at a recent **Tri-City Section** meeting. Mr. Foley's enlightening speech dealt primarily with foundation problems associated with rolling-mill equipment.

The industrious Ladies Auxiliary of the Seattle Section encourages the University of Washington Student Chapter while fostering an interest in art and engineering. Typical of its activities was the presentation of five large framed pictures to the Chapter. Shown at ceremonies are Bill Pye, Student Chapter past-president and recipient of the 1956 Ladies Auxiliary annual scholarship award; Mrs. Elmer E. Gunnette, past-president of the Auxiliary; Robert Brosy, of Timber Structures, Inc.; Paul Jacobsen, of the Pacific Car & Foundry Co.; Rodney Ryker, of the Asphalt Institute; Robert Lochow, of the Portland Cement Association; and Ralph Yoder, of the Structural Clay Products Institute.

ASCE CONVENTIONS

CHICAGO CONVENTION
Chicago, Ill.
Sherman Hotel
February 24-28, 1958

PORTLAND CONVENTION
Portland, Ore.
Multnomah Hotel
June 23-27, 1958

ANNUAL CONVENTION
New York, N. Y.
Hotel Statler
October 13-17, 1958

DISTRICT COUNCIL MEETINGS

DISTRICT 9 COUNCIL CONFERENCE
Akron, Ohio
Sheraton-Mayflower
April 18-19, 1958

DISTRICT 10 COUNCIL CONFERENCE
Atlanta, Ga.
April 11-12

PACIFIC SOUTHWEST COUNCIL CONFERENCE
Phoenix, Ariz.
April 17-19, 1958

LOCAL SECTION MEETINGS

Cleveland—Dinner meeting at the Cleveland University Club, January 17, 6:30 p.m.

Joint Area Committee—Meeting at the University of Toronto, School of Nursing, Room 103, February 6, 6:30 p.m.

Los Angeles—Dinner meeting of the Sanitary Group at the Engineers' Club, Los Angeles, Calif., January 22, 6:30 p.m.

Metropolitan—Meeting in the Engineering Societies Building, January 15, 7 p.m. Demonstration and seminar on electronic computers.

Mid-South—Little Rock Branch dinner meeting at Granoff's Restaurant, Little Rock, Ark., January 15, 7 p.m.

Philadelphia—Dinner meeting at the Engineer's Club, Philadelphia, Pa., January 14, 6:30 p.m.

South Carolina—Annual Winter Meeting, joint meeting with South Carolina Society of Engineers, at the Columbia Hotel, Columbia, S. C., January 17, 10 a.m.

Tennessee Valley—Chattanooga Branch dinner meetings at the Hotel Patten, Chattanooga, Tenn., January 14, and March 11, 5:30 p.m.

NEW HAVEN—Quinnipiac River, All Structural Concrete, D. B. Steinman of New York City

STRATFORD—Housatonic River, Tremie Concrete, Parsons, Brinckerhoff, Hall and Macdonald

BRIDGEPORT—Yellow Mill Pond, All Structural Concrete, E. Lionel Pavlo of New York City

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BRIDGEPORT—Pequonnock River, Tremie Concrete. Ammann & Whitney of New York City

BY-LINE WASHINGTON . . . . .

More money for the 48,000 scientists and engineers in federal service has been approved by the Administration. The move followed on the heels of a special report made last month to the White House, which recommended raising salaries of key employees $125 to $1,000 a year. Other proposals were that Uncle Sam should pay engineers just as well as industry does, open more top-grade jobs to engineers, offer higher salaries to college graduates, and give more fringe benefits.

The White House committee also urged that engineers be given greater opportunity to participate in the affairs of professional societies at government expense.

* * *

Government-employed engineers evaluate job opportunities much as do their professional colleagues in industry, the Committee on Scientists and Engineers for Federal Government Programs has discovered. Some 87 percent of the 20,000 technically skilled men polled by the committee agreed that if professional employees were given a special category, recruitment to government service would be easier. In both public service and private, engineers cited "interest potential" of the job and "integrity of management" as top factors in appraisal of a position.

* * *

Tax relief for self-employed engineers is being taken up again this month by a Congressional committee. The House Ways and Means Committee has scheduled the very important Jenkins-Keogh bill for early consideration in hearings to start in January. This measure, backed energetically by ASCE, would permit self-employed engineers to deduct up to 10 percent of their gross annual income for investment in a private retirement fund.

Spearheading the fight for such consideration is the newly formed American Thrift Assembly, a voluntary organization of professional groups representing engineers, lawyers, physicians, and others. ATA has lined up expert witnesses to argue the case of the self-employed. Passage of the bill would give such individuals the same "break" enjoyed by engineers whose employers provide retirement benefits.

Consulting engineers and others self-employed, affected by this proposal, are being urged by ATA to communicate their interest to their Congressional representative.

* * *

Construction will top $49.6 billion this year, according to the joint forecast just made by the Departments of Labor and Commerce. This healthy 5 percent increase over the record expenditure of $47.2 billion in 1957, will mark 1958 as the second highest year in the physical volume of work put in place, exceeded only by 1955.

Basic assumptions back of the new forecast are that the economic pace will not change significantly, that international developments will not affect construction, that materials and labor will continue in adequate supply, and that costs will continue the trend upward moderately (although at a slower pace than in 1957). [The government's analysis of the construction outlook appears in the "News Briefs" section.]

* * *

Speculation is rife over the possibility of the federal government's retreating from some financial-aid programs. The Administration, which has nourished the idea for several years now, found the Russian launching of "Sputnik" another occasion to talk of reducing "unnecessary" expenditures and, perhaps, letting the states and cities carry their own burdens in some areas of public works construction. Particularly susceptible—urban renewal, water pollution control, airport and school construction.

The Administration has purposely dragged its feet in approving these programs for federal assistance, critics declare, pointing to urban renewal and the National Airport Program as examples (CAA delayed, until last month, its call for project applications for the latter).

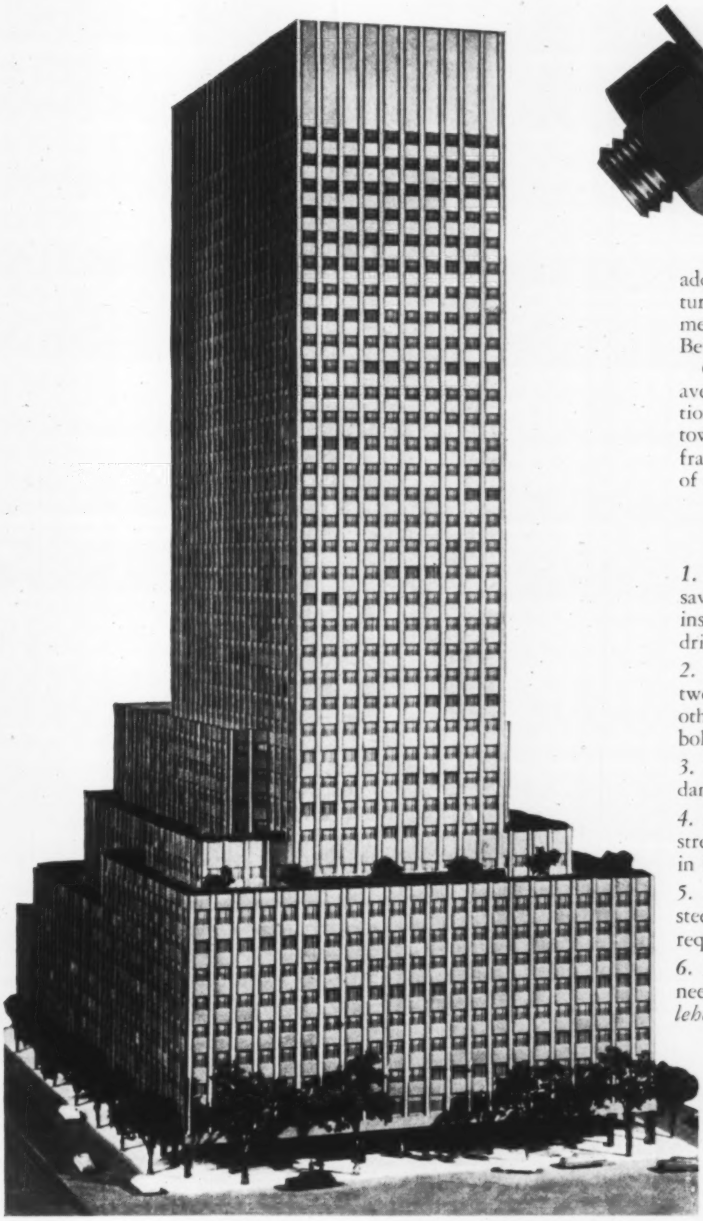
The Federal-State Joint Action Committee, a sixteen-member group of governors and federal officials, pulled together at urging of the President, completed its considerations of possible "turn-backs" last month and presented a number of recommendations to the Governors' Conference. The committee proposed that the federal government end its support of municipal waste treatment plant construction, and that the states take over disaster reconstruction and financial responsibility for planning advances for urban renewal, water use and conservation. The executive committee of the Governors' Conference is going to sit on all these proposals for awhile.

Meanwhile, municipal leaders are all primed to meet the threat of "turn-backs" with plenty of ammunition. A poll of its members by the American Municipal Association reveals that cities want half-a-billion dollars a year for the next decade in federal aid for urban renewal projects, alone.

* * *

A new type of engineering may be involved in the pioneer water de-salting projects discussed in Washington last month. At an international conference on saline water conversion here, scientists described a number of experimental plants now in operation or in the planning to turn sea water into fresh water. Some boasted systems that will accomplish this feat for 20 to 30 cents [for fuel] per thousand gallons. A 2.8-million gallon per day experimental plant is to be built in South Africa soon. In areas where natural fresh water is in short supply, these developments are being watched with keen interest.

Another New Skyscraper in New York with Bolted Steel Framework



Owner and builder: Tishman Realty & Construction Co., Inc.; Architect: Carson & Lundin; Structural engineer: Victor Mayper; Fabricator and erector: Bethlehem Steel Company.

This is 666 Fifth Avenue, an office building destined to be one of the better known addresses in New York City. The 38-story structure has a 13,300-ton steel framework, the structural members of which are joined with thousands of Bethlehem High-Strength Bolts.

666 Fifth Avenue occupies the west side of the avenue between 52nd and 53rd Sts. This air-conditioned structure has a 14-story base and a 24-story tower. White porcelain mullions, set in narrow frames of polished aluminum, extend the full height of the building exterior.

Look at these advantages of Bethlehem High-Strength Bolts!

1. *Save time.* Bethlehem High-Strength Bolts save time in steel erection because they can be installed readily by ironworkers, using power-driven wrenches.
2. *Tight, sound joints.* The bolts are used with two hardened washers, one under the head, the other under the nut. When tightened carefully, the bolts produce high clamping power.
3. *Installed cold.* There's no chance of fire, no danger from tossed rivets which miss the target.
4. *Less noise.* Their use is relatively quiet. High-strength bolting is ideal for joining structural steel in hospital and school zones.
5. *Meet ASTM Spec. A-325.* Bolts are of carbon steel, and are quenched and tempered to meet the requirements of ASTM Specification A-325.
6. *Full size range.* They meet every construction need. *Full details can be obtained from the Bethlehem sales office nearest you.*

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Important Facts from two Studies by the Construction Division of The American Society of Civil Engineers

1. American Society of Civil Engineers members are dominant in all fields of engineered construction—26 major types of projects specifically mentioned.
2. One or more of almost all types of construction equipment are used by Civil engineers on these construction projects.
3. Civil engineers have a major influence in the specification of practically all construction material and installed equipment required to complete the 26 major types of projects.
4. Civil engineers are highly brand conscious and have definite brand preferences for virtually all construction materials and equipment.
5. Civil engineers hold important executive positions and have responsible charge of work in all areas of construction.
6. Civil engineers consult frequently and extensively with their opposite numbers in other organizations in the process of specifying and buying.
7. Civil engineers hold important positions in contractor organizations and select or directly influence the purchase of equipment.
8. Civil engineers in consulting or awarding agencies also influence equipment purchases.
9. Civil engineers spend almost twice as much time reading their Society magazine, CIVIL ENGINEERING, than any other business publication.

Engineers are educated to specify and buy!

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Gurley OP-57

Gurley OP-137

The Gurley Optical Plummet Transit (Model OP-57) has proved itself to be such an important time and money saver in the field that this optical plummet feature has also been added to the Model 132 Standard Precise Transit. The new transit will be known as the OP-137.

Both these Optical Plummet Transits will save you time and trouble in setting over a point. The OP-57 and OP-137 eliminate the swing and sway of the cord and plummet—exasperating and time consuming. You will especially appreciate the increased accuracy on windy locations.

By rotating the instrument 180°, you can be assured of positive centering.

The Gurley Optical Plummet Transits are furnished with tripods which have built-in shifting heads. They allow a two-inch shift of instrument over the point, providing greater latitude in initial set-up.

Model OP-57 is recommended for very exacting work; the OP-137 for general engineering and construction work because of its shorter telescope, smaller size and its lighter weight.

Now in *two* models Gurley offers you an important advantage of the optical-reading theodolite *plus* the simplicity, ruggedness and proved performance of the American transit. *Write for new Bulletin OP-100.*

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NEWS BRIEFS . . .

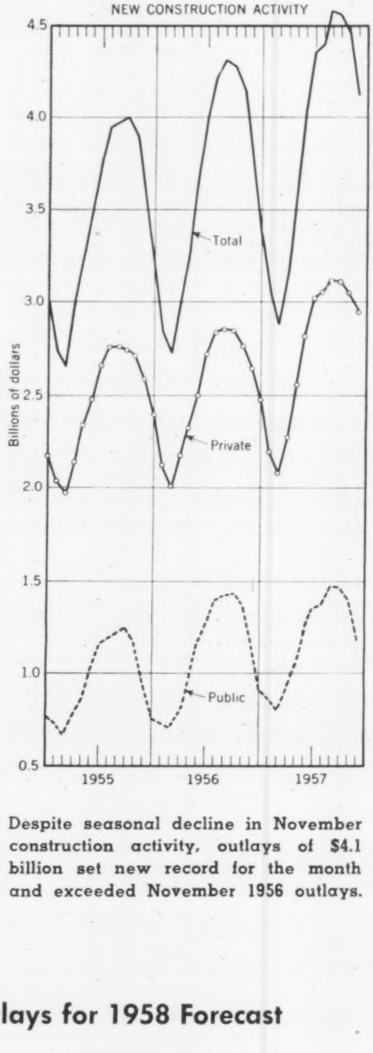
Construction Picture For November

The value of new construction put in place declined seasonally in November, but the $4.1 billion expended set a new record for the month and was 4 percent above November 1956, according to preliminary joint estimates of the U. S. Departments of Commerce and Labor. On a seasonally adjusted basis, November 1957 outlays for new construction were at an annual rate of $48.5 billion.

During the first eleven months of 1957, new construction expenditures came to $43.6 billion, topping last year's first eleven-month total of $42.5 billion by 2 percent and virtually assuring a new annual record of over $47 billion in 1957.

Private construction expenditures decreased 4 percent from October to November, and public outlays were down by 17 percent. Despite these seasonal declines, totals for both private and public construction were at new November highs.

The strong showing for private construction resulted in part from increases over the year in outlays for public utilities, office buildings and warehouses, and hospital and institutional buildings. Private spending for work put in place on new dwelling units remained above $1 billion in November—continuing to show the better-than-seasonal strength evident since midyear. Although all major types of public construction except residential buildings declined from October, the volume of work put in place on highway construction, public educational buildings, and conservation and development projects was greater than in any previous November.



Despite seasonal decline in November construction activity, outlays of $4.1 billion set new record for the month and exceeded November 1956 outlays.

Rise in Construction Outlays for 1958 Forecast

Outlays for new construction in 1958 are expected to total $49.6 billion—some 5 percent above the record expenditure of $47.2 billion evident for 1957, according to joint outlook estimates prepared by the Departments of Labor and Commerce. At this rate of dollar outlay 1958 would be the second highest year in physical volume of work put in place (expenditures adjusted for price changes), exceeded only by 1955.

The $2.4 billion expansion in 1958 construction will be mostly in residential building (private and public) and in highway work, which together are expected to account for $2.1 billion of the gain. Expenditures for almost all other major types of construction will probably rise moderately, or remain at about the 1957 level. The only notable declines will be for private industrial plants and military facilities.

Supply of mortgage funds will continue to be the chief limiting factor in housing activity next year. Some easing in the mortgage market is assumed for 1958, because of increased savings of the types used for mortgages, and also because investment in home loans should benefit from some tapering off in other demands for funds. The outlook assumes a total of about 1,100,000 new non-farm dwelling units will be started in 1958, some 1,050,000 of which will be privately financed. This compares with less than 1,000,000 private units and about 50,000 public units in 1957. Apartment units will constitute a fifth of total housing starts in 1958—the largest proportion since 1949.

Outlays for public housing next year will probably climb to a record $850 million, chiefly to put in place the sharply rising number of armed services (Capehart) units that have been getting under way this year.

Private nonresidential building construction for the first time in six years will not show an increase in outlays. This is primarily due to an expected decline of about 9 percent in industrial construction. Long-range expansion programs for the construction and modernization of many plants have been largely fulfilled, and a substantial volume of new capacity has been added in the past three years. Office buildings and warehouses, especially in buildings with more desirable features and convenient locations, promise another year of expansion to bring annual outlays above the $2 billion mark for the first time. Hospital construction will reach the $600-million mark.

Prospects are that next year public utilities will show a 6 percent advance in spending—about half the 1957 rate of increase. An aggregate of $6 billion will be reached for the first time in 1958, one-fifth greater than 1956 expenditures. The chief areas of spending will be for electric power and gas facilities.

Almost all the expected $1 billion rise in public construction to $14.9 billion will come from state and locally owned projects, and 60 percent of it will be accounted for by the new interstate highway program. Prospects are that total outlays for public highways, streets, and roads will rise sharply, by 14 percent, to $5.5 billion, and that nine-tenths of the gain will occur on the 41,000-mile federally aided system initiated in 1956, for which expenditures (90 percent federal and 10 percent state) will expand from about $250 million this year, to $850 million in 1958. Other highway programs expected to show expenditure gains in 1958 are the basic and continuing federal-aid highway program (which originated with the Federal-Aid Road Act of 1916 and for which matching generally is on a 50-50 basis), and construction of urban and county roads by individual localities. Outlays for roads financed solely by the states, including toll roads, will continue the downtrend that began in 1957, as state funds are increasingly used for the interstate system.

Public educational outlays in 1958 are expected to reach the $3 billion mark, accounting for one-fifth of all public expenditures for new construction. This is more than three times the 1949 level.

Conservation and development programs are likely to continue at about the record 1957 rate, as gains in Corps of Engineers and Bureau of Reclamation programs are offset by a drop in activity on the St. Lawrence Seaway, on which peak construction is now past. Although few large Corps of Engineers projects have been authorized for start in 1958, a number of sizable programs begun in previous years will be reaching peak construction levels next year. On the other hand, increasing expenditures by the Bureau of Reclamation in 1958 will result from work on the early stages of two new projects—the Glen Canyon Dam and diversion of Trinity River waters into the Sacramento River.

Western Europe Expands Its Steel Capacity

Western Europe is well on the way to doubling its prewar steel capacity by 1960, when its annual capacity is expected to rise to about 122,000,000 tons. The impact of this large-scale expansion is likely to be felt all over the world, according to a report of the Committee on Foreign Relations of the American Iron and Steel Institute.

Changes that may be expected, the report notes, include a sharp rise in indirect exports of steel and a 20 percent increase in direct steel exports from Western Europe, as compared to 1955; gains of from 17 to 95 percent in steel consumption over 1955 levels by the major steel-using industries of Western Europe; and greatly increased dependence on non-European (particularly Western Hemisphere) suppliers of raw materials. It is estimated, for instance, that iron ore imports may rise 70 percent above 1955.

The proposed steel expansion between 1956 and 1960 will be largely in the following countries: West Germany, with nine million net tons; the United Kingdom, with six million tons; France with four million tons; and a total of seven million tons in Italy, Belgium, Spain, Sweden, and Austria.

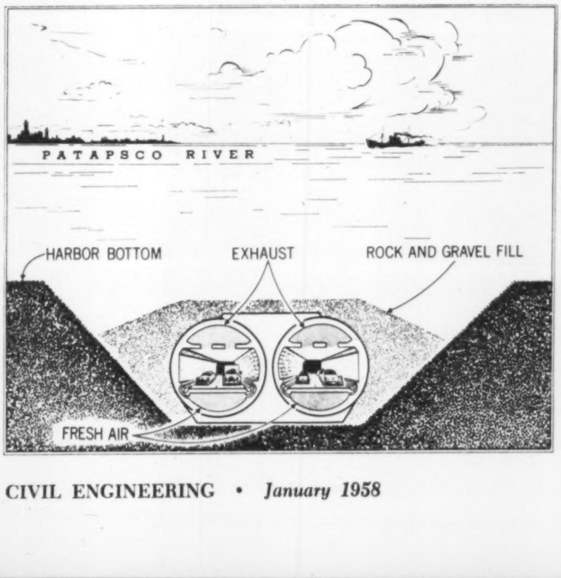
Joint Venture to Plan Guided Missile Base

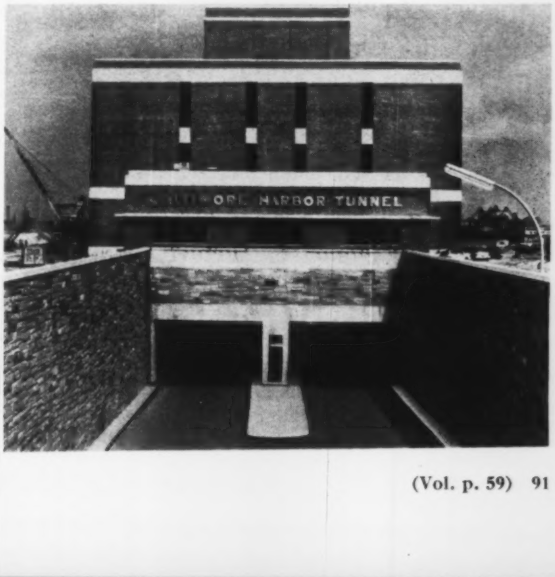
The Strategic Air Command of the U.S. Air Force has awarded Grad, Urbahn & Seelye, architect-engineer joint venture group, a contract to prepare plans and specifications for the multimillion-dollar facilities that will be required at this country's first site for launching the "Snark," an intercontinental guided missile. The facilities are scheduled for construction at an undisclosed East Coast site.

Managing director of the project will be Howard Grad, A.M. ASCE, a partner in the Newark and Washington architectural and engineering firm of Frank Grad & Sons. The joint venture also comprises two New York firms—Urbahn Brayton & Burrows, architects, and Seelye, Stevenson, Value & Knecht, consulting engineers. Organized two years ago, the joint venture has designed military facilities in Pakistan with a construction value of $50,000,000, and is currently acting as consulting architect-engineer on the design of a new jet Naval Air Station at Lemoore, Calif. Its headquarters are at 120 Greenwich Street, New York, with a branch in Washington.

Baltimore Harbor Tunnel Abolishes Traffic Bottleneck

New Baltimore Harbor Tunnel, opened to traffic on November 30, abolishes a 51-traffic light bottleneck, long the bane of East Coast traffic. The former long, slow journey through the city is now reduced to a 15-minute trip. Tolls are 40 cents for passenger cars and from 60 to 85 cents for trucks and other vehicles. The new structure is the world's first twin-tube tunnel of trench-type design. In portal-to-portal length (7,650 ft), it is the longest trench-type tunnel ever built and fifth longest underwater vehicular tunnel. Underwater portion of the project is shown in cross section at left, and portal of completed tunnel in view at right. The J. E. Greiner Company, of Baltimore, was the consulting engineer, and Coverdale & Colpitts, of New York, the traffic engineer. Contracting engineers included Singstad & Baillie, of New York, and Whitman, Requardt & Associates, of Baltimore. Principal contractors were the Merritt-Chapman & Scott Corp., which had a $29,894,000 contract for the river tunnel and shafts, and C. J. Langenfelder & Sons, Inc., with a $25,514,000 contract for one of the land sections and six approach expressways. Construction of the tunnel and approaches was described in the October 1955 and November 1957 issues of "Civil Engineering."





E. J. Peltier Heads Bureau of Yards and Docks

E. J. Peltier

R. H. Meade

Eugene J. Peltier, A.M. ASCE, Captain, CEC, U.S.N., has received a recess appointment from President Eisenhower to succeed Rear Admiral Robert H. Meade, M. ASCE, as chief of the Navy's Bureau of Yards and Docks. Admiral Meade, who has held the office since November 1955, requested retirement from the Navy after 31 years' active duty. Captain Peltier was sworn into his new position, which carries with it the rank of Rear Admiral, on December 2 in a brief ceremony held in the Office of the Secretary of the Navy.

A native of Kansas, the new Bureau chief was graduated with honors from Kansas State College in 1933. He did postgraduate work there toward his master's degree in 1934, and from the latter year to 1940 was a resident engineer for the Kansas Highway Commission. Joining the U.S. Naval Reserve in 1936, he was called to active duty in 1940. In June 1946 he was transferred to regular status in the Civil Engineering Corps, attaining the rank of captain in 1952.

During the war Captain Peltier served as officer-in-charge of the 137th Naval Construction Battalion, and after the war commanded the 54th Naval Construction Regiment, also on Okinawa. His postwar duty included assignments as public works officer at Pensacola and Jacksonville, Fla., Memphis, Tenn., and Pearl Harbor, T. H. Before assuming his post at Port Hueneme, he was also Assistant Chief for Maintenance and Materiel in the Bureau of Yards and Docks.

Admiral Meade is a graduate of the Naval Academy, with a distinguished record of service. He commanded wartime construction brigades in Alaska, the Aleutians, and the Philippines. Immediately prior to his appointment as chief of the Bureau of Yards and Docks, he was director of construction for the Joint U.S. Military Group in Spain.

International Navigation Congress Held in London

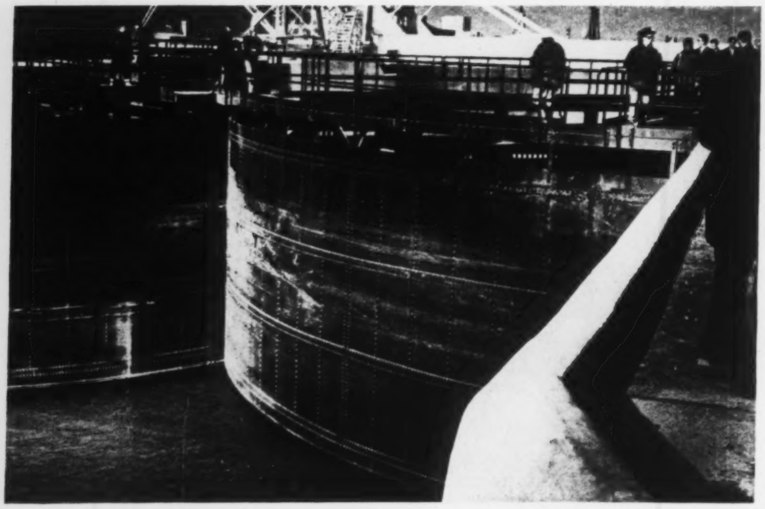
More than 1,000 engineers, economists, managers and operators attended the recent nineteenth International Navigation Congress, which was held in the Great Hall of the Institute of Civil Engineers in London. The Permanent International Association of Navigation Congresses was organized in 1898, with headquarters in Brussels. As of April 1957, membership consisted of 53 governments, 597 corporations, and 1,898 individuals. A 1902 Act of Congress authorized the United States to become a member of PIANC. International congresses are held at four-year intervals for the purpose of considering ways of increasing the efficiency and effectiveness of waterways, ports and harbors.

A business session, inspection trips, two separate Section meetings for presentation and discussion of technical papers, and post-congress excursions to localities of technical interest constituted the London congress program. Subjects pertaining to inland navigation were discussed by those attending Section I; aspects of ocean navigation were the theme of the simultaneous meeting of Section II.

The official United States delegation consisted of 27 members, headed by Maj. Gen. Charles G. Holle. In charge of Section I were Brig. Gen. Herbert D. Vogel, vice-chairman, and Carl B. Jansen, secretary. For Section II, Brig. Gen. Theron D. Weaver was vice-president, and Thorndike Saville, Jr., secretary. All are members of ASCE.

General Holle reports that negotiations are under way to hold the next congress in the United States in 1961.

First Completed St. Lawrence Seaway Lock Is Tested



Iroquois Lock on the St. Lawrence Seaway Project has been completed under supervision of the Canadian St. Lawrence Seaway Authority. It has a length of 768 ft, width of 80 ft, and 30 ft of water over the sills. Lift of the lock will be 6 ft. But for part of the next navigation season it will be 22 ft, pending completion and filling of the reservoir above Barnhart Island power dam. Filling and emptying of the lock is by slow opening of the sector gates, shown here under test, rather than the usual separate gates in tunnels. Filling or emptying time under normal conditions is five minutes. Iroquois Lock will provide access between the power pool in the International Rapids Section of the Seaway and the stretch of river upstream leading through the Thousand Island section to Lake Ontario.

AASHO Program Urges

Better Public Relations

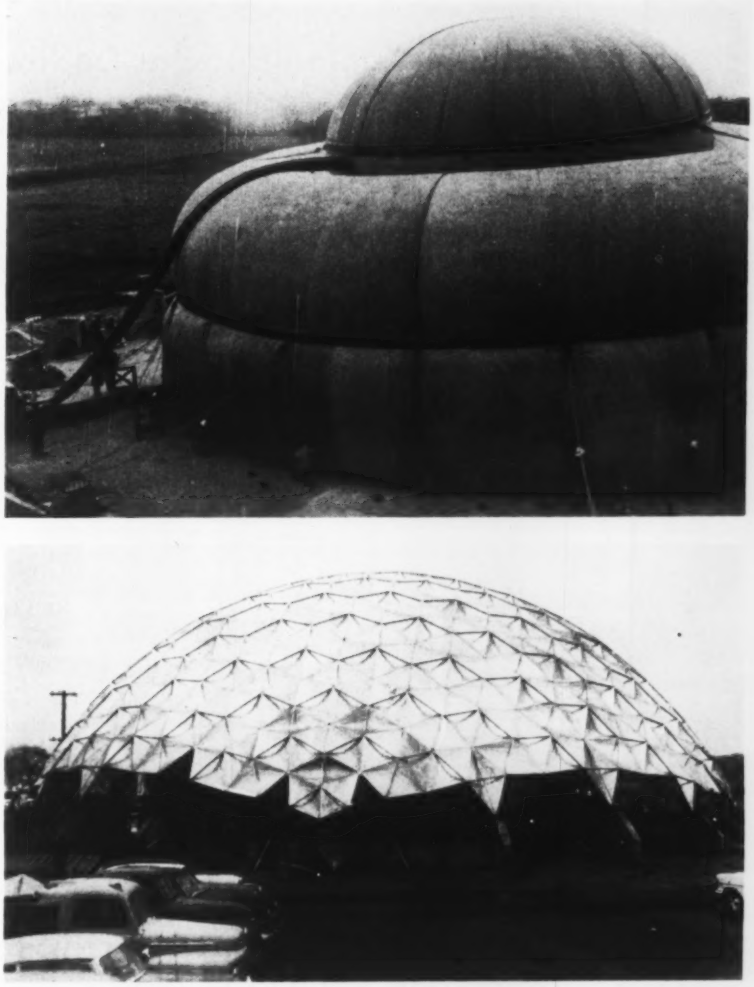
Improved relations with the public was the principal theme of the American Association of State Highway Officials' annual meeting held in Chicago, November 18-22. Sessions covering all phases of financing, design, construction, and maintenance were well attended by the 1,600 registered members and guests. However, meetings on the subject of planning for the future, right-of-way-procurement, and dealing with the public proved of greatest interest.

The importance of public opinion to the successful start of work on the Interstate System of highways was emphasized. The federal government requirement of public hearings before final selection of routes seems to get varying attention in different states. Wisconsin, which has had a similar state requirement since 1917, took the lead in recommending that top highway department men attend each meeting; that meetings be fully advertised well in advance with all available information made public; that the project be fully explained by a competent speaker; and that all persons be given all the time to speak they want—even if they ramble. But Wisconsin has found that if meetings start at 10 most folks will leave for lunch by 12:30.

A ten-point public relations plan was outlined by L. W. Prentiss, executive vice-president of the American Road Builders Association. Mr. Prentiss stressed that: (1) the engineer in public office works in a goldfish bowl and must always think and practice good public relations; (2) every member of the staff from the clerks and field men up must be made part of the public relations team; (3) the mission of a public relations office is not to play up to the boss but to be fair, accurate, and thorough; (4) your job is important so you do not have to act important to impress people—it doesn't work anyway; (5) cooperation with district engineers is essential to indoctrinate them on problems of the bypass, limited access, economic benefits, and the like; and (6) the confidence and support of the newspapers, bankers and civic leaders must be obtained for each step of the program. Finally, said Mr. Prentiss, send a man with reputation and authority to do the recruiting of engineers—it pays.

Controlled access will give us highways that have a much lower accident cost per mile, said C. D. Curtiss retiring U.S. Commissioner of Public Roads, citing a Massachusetts example of $19,000 a mile annual accident cost on controlled access highways compared to $82,000 on comparable non-controlled roads. Mr. Curtis recommended that highway departments build up their own personnel for the huge program ahead, depending upon consultants only for specialized services. On such consultant services as are used fees should be in line with schedules such as that of ASCE.

W. A. Bugge, director of highways for the state of Washington and president of AASHO, reminded the highway engineers that they are the ones responsible for the Interstate and A, B and C road programs. He asked that the Bureau of Public Roads speed approval of plans for new projects and recommended no additional mileage for the Interstate System unless it can be accompanied by adequate financing. But for other items he put the challenge squarely on the highway engineers to make better progress, control costs, and avoid irregularities in right-of-way acquisition.



Balloons Speed Erection of Aluminum Dome Building

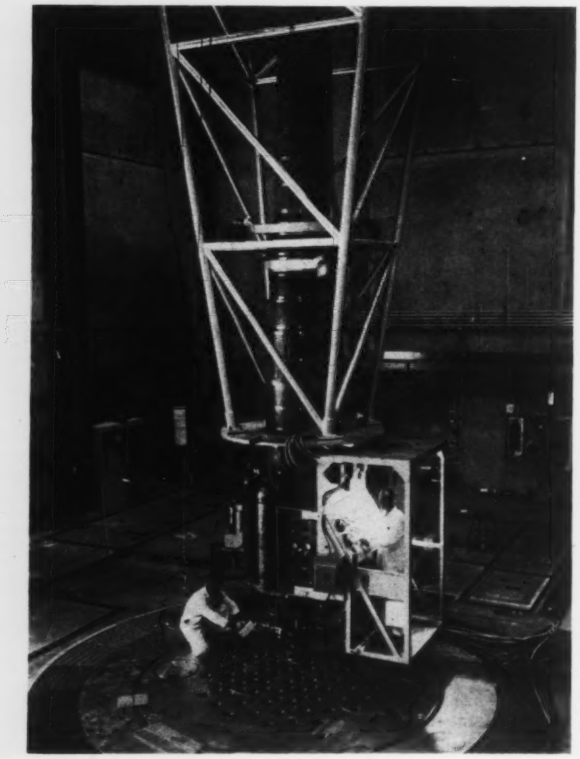
Unique construction method, using two balloons as a supporting scaffolding and elevating device, made it possible for a 38-man crew to complete a 145-ft-dia Kaiser Aluminum dome factory building at Abilene, Kans., in 22 working hours. The two balloons raised the five-story-high dome onto piers (3 to 6 ft off the ground), which form the anchoring foundation of the big structure. Top view shows both balloons fully inflated, to a height of 54 ft, on the concrete slab floor for the dome structure. Both were anchored by cables running from channel bars at the sides to eye-bolts in the concrete. Blowing equipment is shown at the left, in the same photo. Final panels that anchor the dome on its concrete piers are being added in lower view of the dome's exterior. After the panels were attached, the balloons were deflated and removed. Dome was erected by the Fi Fo Construction Company, a division of the Vacu-Blast Company of Belmont, Calif., and licensed fabricator-erector of Kaiser domes.

Small Sodium-Cooled Reactor Dedicated in California

Hidden among the rocky folds of the Santa Susana Mountains 30 miles northwest of Los Angeles is the first nonmilitary nuclear reactor, built for the production and distribution of commercial electric power by a private utility. This 6,500-ekw reactor (20,000 thermal kw)—a small-scale experiment fueled with enriched uranium, cooled with liquid sodium, and moderated with graphite—is called the Sodium Reactor Experiment (SRE). It went critical on April 25, 1957, began generating electricity on July 12, and was shown to the press at its dedication, by Lewis L. Strauss, chairman of the Atomic Energy Commission, on November 14. The plant was built by Atomics International, a division of North American Aviation, Inc.

Heat from the nuclear fission in the core of the reactor is absorbed by circulating liquid sodium pumped to an exchanger where the heat is transferred to a non-radioactive liquid sodium circuit. From this latter circuit heat is extracted by the Southern California Edison Co. in an adjacent plant to drive a conventional turbo-generator of 7,500-kw capacity (Fig. 1).

Sodium has several characteristics favorable to its use as a coolant. Its low melting point and high boiling point permit generation of steam at temperatures and pressures comparable to those of conventional steam power plants. The low pressure in the primary system reduces the containment problem in the reactor vessel. This metal has low neutron-absorbing qualities and good heat-transfer properties. All materials within the core are compatible—violent chemical reactions will not occur. The outlet temperature of the sodium is about 960 deg. F. An added safety feature is that as temperature rises power falls off—a negative temperature coefficient.



New fuel rods may be inserted in the core without special biological precaution. Spent rods are radioactive, and at SRE are withdrawn into the lead-shielded, fuel-handling cask shown.

The reactor core, the primary sodium heat-transfer system, and the fuel storage cells are contained in a steel-lined concrete tank sunk below ground level. The removable lid of the tank is a massive high-density concrete biological shield 6 ft thick. The core, 6 ft in dia and 6 ft high, contains an array of 119 vertical hexagonal canned graphite blocks, the moderating material. In forty-three of the blocks fuel elements are inserted.

Each fuel element consists of a cluster of seven vertical rods suspended on a common hanger so that all seven rods can be removed and replaced at one time. The rods are 6 ft long, made up of 0.75-in.-dia. metallic uranium slugs 6 in. long sealed in a thin stainless-steel-jacket tube, with sodium-potassium contained in the tube for thermal bonding. Full power operation will require forty-three of these fuel elements. The reactor is currently loaded with about 3,000 kg of uranium, enriched by 2.78 percent of U^{235}. It is intended to experiment with other types of fuel elements. The intensity of the reaction in the core is controlled by inserting into the core four control rods, each consisting of a column of boron-nickel rings assembled on a tube.

Contract funds for the reactor total $17,733,000, of which Atomics International contributed $2,850,000. Research and development cost, the largest part of the total, amounted to $8,945,000. In addition, the Southern California Edison Co. installed at its own expense a steam-turbine-driven generator plant at a cost of $1,400,000.

In his dedicatory address Chairman Strauss said, "The valuable technology obtained in the design, construction, and operation of this experimental reactor, will be used for the building of a commercial-size nuclear reactor of this same design but with a power capacity ten or twelve times greater [750,000 ekw]. The full-scale plant will be built [1962 or 1963] for the Consumers Power District of Nebraska, which will provide the site for the plant, build its conventional turbo-generator facility, and contribute some $5,000,000 toward the construction of the nuclear portion of the plant. . . . Our hopes for this type of plant are based largely on low construction cost and high performance."

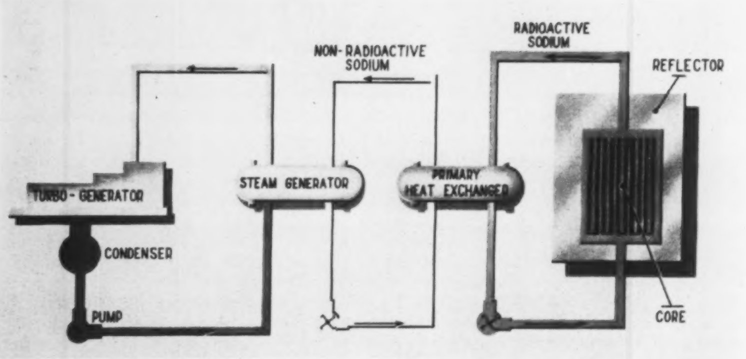
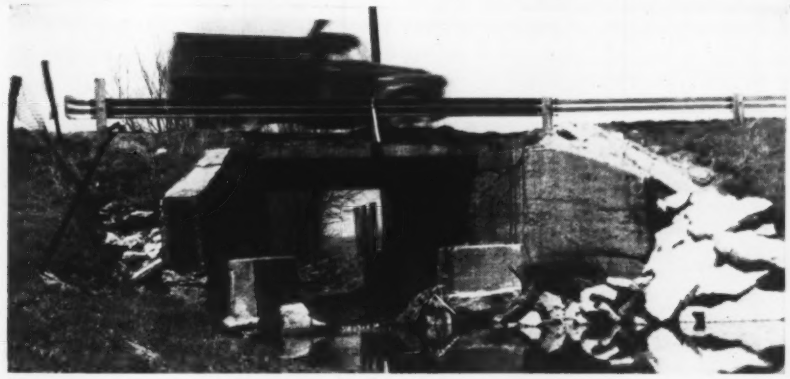
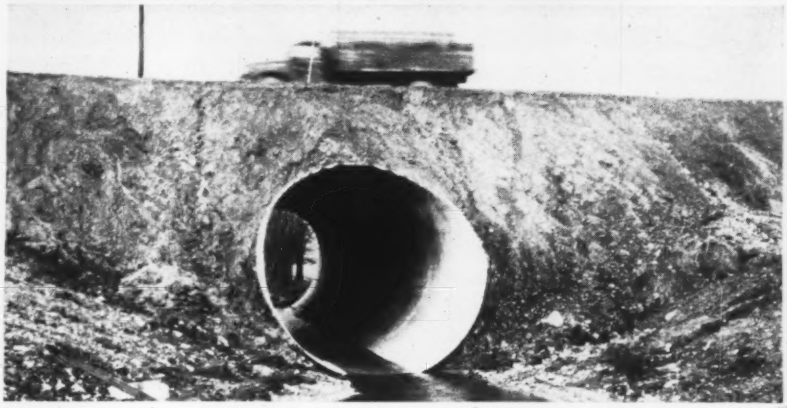


Fig. 1. Fundamental steps in producing electric power from nuclear reactions in the Sodium Reactor Experiment (SRE) are shown in artist's sketch. The reactor was built by Atomics International in the Santa Susana Mountains, California.



BEFORE

The bridge was narrower than the approach roadway. Notice large cracks in abutment.



AFTER

Multi-Plate Pipe made it possible to widen roadway with almost no reduction in waterway area. The ends of the pipe are beveled to fit the finished slope.

Armco MULTI-PLATE Pipe replaces narrow, failing bridge

New structure permits wider roadway, greater loads

An old concrete bridge on the Dayton-Yellow Springs Road in Greene County, Ohio, presented a dangerous traffic hazard. The bridge was scarcely wide enough for two cars. In addition, the old structure was weakened by crumbling abutments.

The county replaced the bridge with a 15-foot-diameter Armco Multi-Plate® Pipe under a 12-foot earth cover. This made it possible to widen the roadway so cars could pass safely. And the problem of load limit was eliminated.

Multi-Plate Pipe is one of many Armco products used for economical drainage and construction. Others include foundation piling, bin-type retaining walls, tunnel liner plates, sewer pipe, and steel buildings. There is a size and type of Armco product to help you solve practically any drainage or construction problem.

Write for data on the products that interest you. Armco Drainage & Metal Products, Inc., 4067 Curtis Street, Middletown, Ohio. Subsidiary of Armco Steel Corporation. In Canada: write Guelph, Ontario. Export: The Armco International Corporation.

Pneumatic tampers were used to compact earth under the haunches of the pipe.

Armco Construction Products

Contract for Building Atomic Merchant Ship

A contract for construction of the world's first nuclear-powered merchant ship, the *NS Savannah*, has been awarded to the New York Shipbuilding Corp., of Camden, N. J., on a fixed-price basis for $20,908,774. The awarding agencies were the Maritime Administration and the Atomic Energy Commission. The contract provides for construction of the ship and for installation and testing of its nuclear propulsion system, which will be furnished by the Babcock and Wilcox Company under a separate contract with the AEC.

The *NS Savannah* was designed by George G. Sharp, Inc., of New York, which prepared the contract plans and specifications and performed associated engineering work. Of all-welded construction, it will be 587 ft long and 78 ft in beam, with full load displacement of 21,800 tons. It will accommodate 60 passengers.

Operation of the entire power plant, both nuclear and conventional components, will be remotely controlled from a single console located in an air-conditioned control room adjoining the machinery space. The nuclear power plant will be of an advanced pressurized water design, and the propulsion equipment a steam turbine connected to a single propeller shaft through double reduction gears. Service speed will be 20 knots.

Award of the construction contract keeps on schedule plans for the nuclear-powered merchant ship. The plans call for the keel-laying in 1958, launching in 1959, and operation on the high seas in 1960.

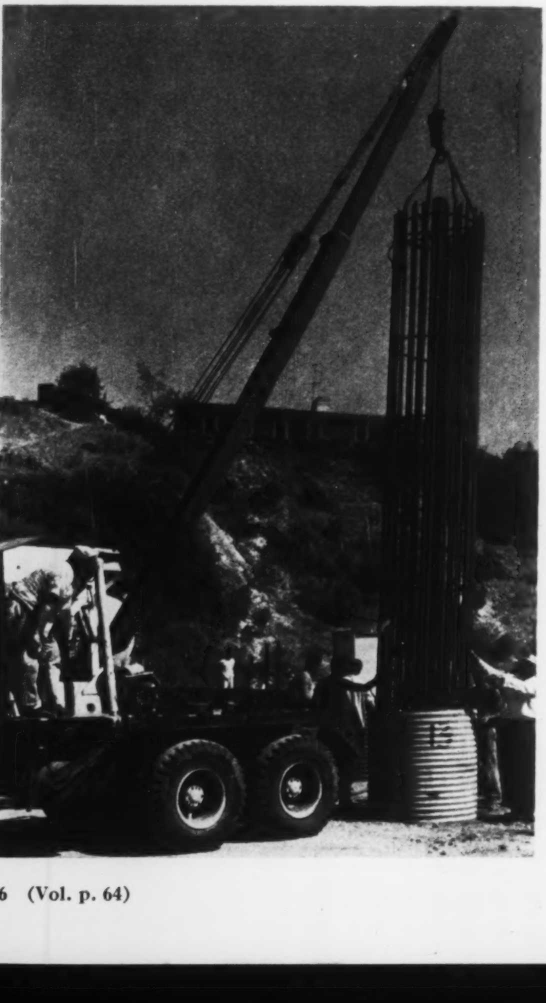
Giant Spikes Halt Earth Movement in California

Fifteen super "spikes" were recently used in the Portuguese Bend residential area, just south of Los Angeles, to keep more than 35,000,000 tons of earth from slipping into the sea. In the past year the earth has slipped 30 ft toward the ocean, forcing many families to abandon their homes and threatening destruction to $1 million of county improvements. The system of "spikes" or caissons—developed by Charles Macintosh of Macintosh and Macintosh, Engineers—has slowed the rate of movement from 1¼ in. a day to .3 in. a day. As a result of this slowing, geologists expect, the natural forces of cohesion and friction will soon stop the slippage permanently.

Each of the 22-ton, 20-ft-long caissons contains about two tons of No. 11 reinforcing bar, rolled at Bethlehem Pacific's Los Angeles plant and fabricated by the Meehelis Steel Company into specially designed reinforcing cages for the caissons. The cages were fabricated into two rings of vertical bars, the inner ring being staggered to allow the maximum number of bars with maximum clearance.

The caissons were then lowered into casting holes, lined with sheets of Bethlehem's Beth-Cu-Loy, which acted as a container and as a further tie for concrete outside the outer ring of bars. After casting, the caissons were allowed to cure for a week until the concrete reached a minimum compressive strength of 2,000 psi. Then the concrete and steel reinforced "spikes" were moved from the casting holes to the placement sites, where they were lowered to a position across the slip plane at the slide base.

The slip plane, ranging from relatively near to 180 ft below the surface, rests on a sandstone base. Each caisson penetrated the sandstone base to a depth of 10 ft and extended upward into the clay for the other 10 ft to pierce the slikenside or slip plane.



Prior to pouring, cage of reinforcing bars is lowered into the casting hole. Each of the fifteen caissons used featured the staggered pattern of reinforcing bars visible here.

Turbines for Tuscarora Plant of Niagara Power

Twelve large reversible pump turbines for the Tuscarora plant of the Niagara Power Company will be built by the Allis-Chalmers Company in a joint venture with the S. Morgan Smith Company, of York, Pa. To meet shipping schedules, which call for delivery of the huge units at 45-day intervals beginning September 1, 1959, half of the order will be filled at the West Allis, Wis., works of Allis-Chalmers and the other half at York. Each of the units has a rated capacity of 3,400 cfs. Their total cost will be over $11,000,000.

The Tuscarora plant and a large storage reservoir will be located on the plateau about a mile inshore from the Niagara River and three miles below the falls. It will be near Lewiston, N. Y., where the main Niagara power plant is to be built. The two plants together are expected to develop about 3,000,000 hp.

By international agreement the flow of water over the falls is kept at 100,000 cfs during the daytime in the tourist season, and reduced to 50,000 cfs during the non-tourist season and at night. By means of the reversible pump turbines and use of low-cost, off-peak power, the Tuscarora plant will be able to save the surplus water available at night by pumping it into the storage reservoir. During the day, when less power is available and more is needed, the pumps will be operated as hydraulic turbines to drive generators. At the same time the surplus water released from the Tuscarora turbines will produce additional power for the new Lewiston plant.

Road contractor's 6-Payhauler® fleet

outhauls competitive rigs...up to 2-to-1!

"When we pulled a '65' Payhauler unit off the stockpile for another job, two of our other off-highway trucks were needed to replace it," reports Supt. Virgil Rice, for Cage Brothers, San Antonio, Texas. This Payhauler trio is running circles around other outfits, on a 12-mile road-rebuilding project near Snyder, Texas!

Prove the get-away surge, and up to 25% faster haul speed of an International Payhauler—the result of bonus turbo-charged diesel power; road-matched and load-matched gear choice; and the power-cushioning leverage of planetary drive axles.

Try Payhauler "pick-up truck" spotting ease. Exclusive high reverse, "zip-around" power steering, and grade-beating power get the credit! See how 12-second dumping with double-acting hydraulic hoist speeds the cycle. Measure the effect of Payhauler operating ease, and downgrade safety, for example, of positive Torqmatic braking! See your International Construction Equipment Distributor for a demonstration!

"I'm just sorry all our haulers aren't International Payhauler units," adds Supt. E. R. Rice. "They haul bigger loads, faster; give less trouble; and operators like them better than our other new haul units." This Mr. Rice rides herd on another Cage Brothers' 3-unit Payhauler team—setting a fast tonnage pace, hauling limestone for highway resurfacing, near Abilene.

International® Construction Equipment

International Harvester Co., 180 N. Michigan Avenue, Chicago 1, Illinois

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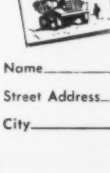

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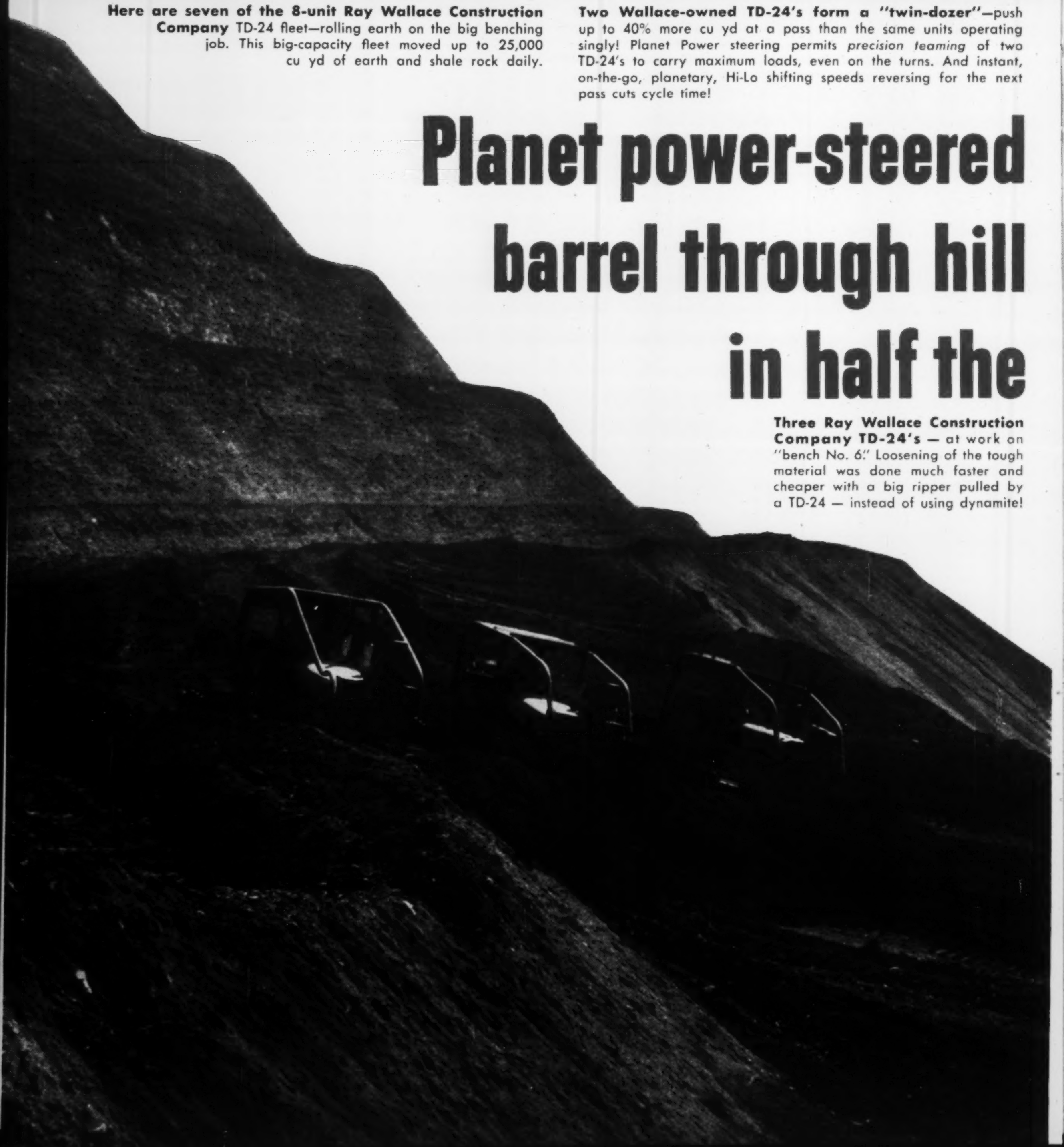
Gentlemen:
☐ I am a contractor. ☐ Am interested in becoming a contractor. ☐ Am an equipment operator (please check square that applies). Send me Payhauler Catalog (CR-603-G).

Name____
Street Address____________________________________
City____________________________State____________

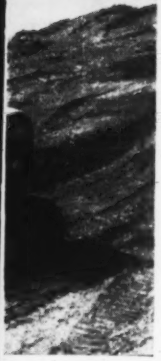
Here are seven of the 8-unit Ray Wallace Construction Company TD-24 fleet—rolling earth on the big benching job. This big-capacity fleet moved up to 25,000 cu yd of earth and shale rock daily.

Two Wallace-owned TD-24's form a "twin-dozer"—push up to 40% more cu yd at a pass than the same units operating singly! Planet Power steering permits *precision teaming* of two TD-24's to carry maximum loads, even on the turns. And instant, on-the-go, planetary, Hi-Lo shifting speeds reversing for the next pass cuts cycle time!

Planet power-steered barrel through hill in half the



Three Ray Wallace Construction Company TD-24's — at work on "bench No. 6." Loosening of the tough material was done much faster and cheaper with a big ripper pulled by a TD-24 — instead of using dynamite!



"When I get bigger and tougher jobs, I just get more International TD-24's," states contractor Ray Wallace. "In a tight road-building schedule, our first TD-24 cleared its purchase price in only 28 days; was first overhauled at 8,700 hours. None of our equipment has lost time here, and we've cut the engineer's estimate in half! You can't get better performance than this."

TD-24's – benching job estimated time

How International power exclusives give you a new basis for getting and fulfilling profitable contracts!

A series of seven huge benches had to be carved around this 350-foot-high hill—to rid California Rt. 1 of a dangerous slide area, near Rockdale.

Each self-draining bench is 50′ high, and 20′ wide on top. 800,000 cu yd (25% earth, 75% shale rock) had to be moved, primarily in curved "passes."

Ray L. Wallace Construction Co., Westport, California, won the contract by basing his bid on Planet Power-steered TD-24 performance and its proven ability to move and "hold" bonus yardage loads on turns as well as straight-aways! And his eight TD-24's did the job in only half the time the engineer estimated!

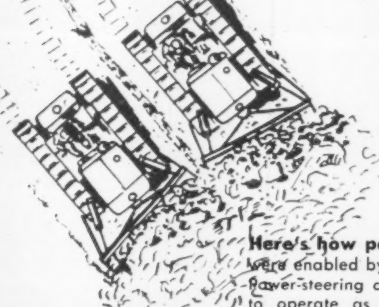
The difference: BIG TD-24 power exclusives

TD-24 power exclusives can often help you "run power circles" around conventionally steered, and geared king-sized crawlers!

Proven Planet Power steering, for example, eliminates "dead track drag" on the turns—gives full-time "live" power on both tracks while turning—enables the TD-24 to pull or push as big a load on the turns as on the straight-aways. Extra yards per pass mean bigger bonus yardage per day!

Cycle-speeding, TD-24 Hi-Lo shifting permits instant, on-the-go speed-changing—to faster or slower, either in forward or reverse. Instant speed adjustment to the load without stopping takes full-time advantage of full power! And planetary Hi-Lo shifting speeds up TD-24 shuttle-dozing cycle time—increases the number of passes per hour; thus increases TD-24 capacity!

See for yourself how these and other International TD-24 power exclusives arm you with a new, job-getting, profit-building basis for getting and fulfilling contracts. Ask your International Construction Equipment Distributor for a TD-24 demonstration!



Here's how pairs of TD-24's were enabled by exclusive Planet Power-steering and Hi-Lo shifting to operate as *precision teams*. They massed their combined 400-hp plus, and formed a huge U-blade that moved a gigantic yardage per push. The extra yardage equalled a "dirt-dividend" of up to 40%—compared to two dozers, operating singly!

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N★ G★ Neare's COLUMN

R. ROBINSON ROWE, M. ASCE

"I like," mused the Professor, "profound problems that look trivial. As trivial as a professional jumping frog so blind that its 10-ft hops go off in all directions. The probabilities of a 2-hop jump would be simple, but Mark Twain's 3-hop contest has bogged down more mathematicians than lead-bellied frogs. So while I asked Cal for the probability that Random jumped more than 20 ft, Joe had only to figure the chance of a jump under 10 ft. No trouble, was there, Joe?"

"None at all—and I did both problems. I oriented Random's first hop on line OA (Fig. 1) and let ABC be a typical path for the other two hops. Now the closing distance AC can be any distance from 0 to 20, so C can be anywhere in circle DEFG. The area of that circle is a measure of all possibilities. And comparatively the measure for a jump under 10 ft is the circle AE which is one-fourth as large. For Cal's problem, the measure is the crescent DGFH which has a harder area to figure. But I did it; the chance of a jump over 20 ft is 0.315, the ratio of areas of crescent and 20-ft circle."

"Yes and no," equivocated Cal. "Equal probability in circle DEFG is not proportional to area, but follows uniform variation of the angles at A and B. Fortunately for Joe, variability runs the gamut in circle AE, so his answer of 0.25 is correct for a jump under 10 ft, but I challenge his other answer."

"You've challenged a wrong answer," shouted the Professor. "Correct it and you're still champion and the winner of 64 cents."

"Easy money! Considering the upper half of the symmetrical figure, I generated the field of equal probability by varying angles at A and B uniformly from 0 to 180°. For cases with 2θ for the angle at B, the locus of C is a semicircle of length πr of which ϕr is in the crescent, where

$$r = 20 \sin$$

$$20r \cos \phi = 300 - r^2$$

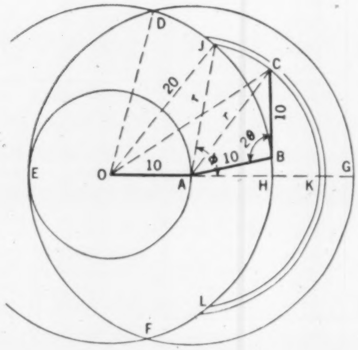

Fig. 1. Frog hopping from O to A to B to C had Joe running around in circles.

$$p = \frac{1}{\pi} \arccos (.75 \csc \theta - \sin \theta)$$

"Now θ has to vary from 0 to 90°, but the probability p is real only in the range 30° to 90°. Integrating for mean value,

$$P \int_0^{\pi/2} d\theta = \frac{1}{\pi} \int_{\pi/6}^{\pi/2} \arccos (.75 \csc \theta - \sin \theta)\, d\theta$$

$$P = \tfrac{1}{3} - \frac{2}{\pi^2} \int_{\pi/6}^{\pi/2} \arcsin (.75 \csc \theta - \sin \theta)\, d\theta = 0.304$$

"That's my answer, but I admit I used a series to integrate the elliptic."

"It's good enuf for the 64 cents and a cake of our famous Softie Soap," concluded Professor Neare. "I'd like, for a sequel, to see what you could do with a 4-hop jump, but I signed a New Year's resolution to give you easier problems in 1958—for at least one month.

"The first one is a very practical highway right-of-way deal. The thruway from Coon Hollow to Catter Corners will run diagonally thru a completely fenced square section of land. Ordinarily the right of way is a strip 100 ft wide each side of centerline, but the new boundary must be fenced and fencing is expensive and land costs only $435.60 per acre, so we acquired an additional triangle of land in each 45° corner. For one such triangle, the section line bears North, the thruway side N 45° E, and the length along the thruway is 200 ft. How should the third side bear?"

[Cal Klaters were Thatchrite (Guy C. Thatcher), S. K. Rueball (Keith Jones), and Rudolph W. Meyer. Also acknowledged are solutions of the clown-ladder problem from German Gurfinkel, Laurence V. Degnan, L. M. Christiansen, and Ad L. Pate (G. H. Wilsey).]

Welded Aluminum Bridge

Aluminum will be used for structural members of a 220-ft four-span continuous girder to carry a local road over a section of the Interstate Highway System near Des Moines, Iowa. Spans are 41 ft 3 in., 68 ft 9 in., 68 ft 9 in., and 41 ft 3 in., for this pioneer structure, to be built by the Iowa Highway Commission.

Four lines of aluminum girders are spaced at 9-ft 6-in. centers under the 30-ft-wide concrete roadway, plus 2-ft-wide curbs. The girders are to be fabricated by welding three plates together to form an I-section, using the shielded inert-gas metal-arc welding process. The bridge is designed to meet H20-S16 loading.

The bridge is supported on concrete abutments on timber piles and three concrete piers on steel piling, driven to refusal on shale. It was designed by Ned L. Ashton, of Iowa City, working with Mark Morris and Neil Welden, of the Highway Commission, and with three large aluminum suppliers.

Six bids were received December 10 for completion of the bridge by July 5, 1958. The three low bids, all from Des Moines firms, were: the Jensen Construction Co.-United Contractors, $124,683; A. H. Neuman, $129,050; and Iowa Bridge Co., $131,706. It is expected that award will be made to the low bidder.

Bulletin Gives Data on Overseas Construction Jobs

Latest information on foreign construction projects will be provided in a new monthly bulletin announced by Overseas Americans Inc.—a recently formed organization that will act as a clearing house for collecting, analyzing, and exchanging information on foreign engineering and construction projects either being built or under consideration. Inquiries about the publication should be referred to the headquarters of Overseas Americans at 7 West 44th Street, New York 36, N. Y. Herbert U. Ross is president of the new group, and C. Foster secretary and treasurer.

Manila Bay Dredging Project

The Hawaiian Dredging & Construction Company, Ltd., has been named low bidder on a large Manila Bay dredging project. The project, which is being sponsored by the Philippine Government Department of Public Works, will involve the removal of more than 5,232,000 cu yd of material from Manila's South Harbor. The dredging will be accomplished by a 268-ft hopper dredge. It is estimated that it will take about a year. Cost of the project will be over $2,000,000.

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do justice to
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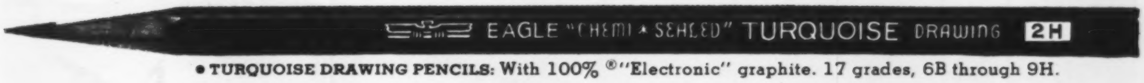

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(added to the Engineering Societies Library)

Symposium On Wood For Marine Use And Its Protection From Marine Organisms

The first paper in this symposium discusses the kinds of marine borers and indicates how they may be a danger to structures of wood and other materials. This paper includes a selected, annotated bibliography. Other papers deal with method of testing service life of marine piling treated with various preservatives; tests of heavy metal compounds as preservatives; and the service life of creosoted piling. Published by the American Society for Testing Materials, 1916 Race Street, Philadelphia 3, Pa., 1957. 52 pp., $2.00; to members, $1.50.

Roads, Rails & Waterways

This non-technical account of the activities of the Engineer Department of the United States War Department in the exploration of the country and in the construction of roads, waterways, lighthouses and other public works from 1815 to the Civil War will interest students of economic and military history and the history of transportation. Extensive bibliographical references are included by the author, Forest G. Hill. University of Oklahoma Press, Norman, Oklahoma, 1957. 248 pp., $4.00.

Reinforced Concrete Designer's Handbook

Part I of this handbook, by Charles E. Reynolds, contains explanatory notes on the design of foundations, retaining walls, bridges, buildings, roads, etc., with references to the pertinent design tables grouped in part II. Part III gives examples of design requiring reference to more than one table, and part IV is concerned with specifications and quantities. The material in this edition has been revised in accordance with the new British Standard Code of Practice for Reinforced Concrete in Buildings, 1957, and in particular with the load-factor method of design of beams now included in the Code. Concrete Publications Limited, London, S. W. 1, England. 343 pp., $4.00.

Symposium On Full Scale Tests On House Structures

The included papers cover tests on houses built of plywood stressed-cover panels, on prefabricated buildings, and on pre-cast multistory flat construction. There is also a report on a structural test of a house under simulated wind and snow loads. ASTM Special Technical Publication No. 210. Published by The American Society for Testing Materials, 1916 Race Street, Philadelphia 3, Pa., 1957. 60 pp., $2.50.

Acoustics For The Architect

This manual, by Harold Burris-Meyer and Lewis S. Goodfriend, provides the architect or engineer with the tools needed for handling acoustics and noise control in the structures he designs. It discusses briefly architectural elements and their acoustical properties, sound systems, and other electronic devices; gives complete design procedures for a wide range of structures; and provides charts, tables, and check lists which simplify the necessary acoustical calculations. A separate pamphlet lists sound absorption coefficients for architectural acoustical materials both by type and manufacturer. Reinhold Publishing Corporation, 430 Park Avenue, New York 22, N. Y., 1957. 126 pp., $10.00.

Estimating General Construction Costs

Second Edition, 1957

A revised edition of a work privately published by the author's company in 1954. Louis Dallavia, a construction estimator by profession, here presents a system that is applicable to a wide variety of job conditions. Based on 160 tables of specific operational costs the system outlined provides basic cost and production data, which are then modified according to a productivity index derived from 25 project conditions such as labor, equipment, weather, and the general economy. Sample checklists and form sheets are shown in the appendix. Published by the F. W. Dodge Corporation, 119 West 40th Street, New York 18, N. Y. 197 pp., $8.50.

The Building Estimators Reference Book

14th Edition, 1957

There is a great deal of up to the minute cost information in the 14th edition of this standard estimating volume by Frank R. Walker, A.M. ASCE. Much additional data is included on new building materials, steel floors and sandwich walls, for example. Prices are current—$3.45 per hour is used for carpenters with space left at every item for the estimator to insert local wage rates and materials prices. Very well illustrated. With the 1780-page book is the Walker 220-page Vest Pocket Estimator with data in tabular form. Published by the Frank R. Walker Co., 173 West Madison, Chicago 2, Ill., $13.50.

Symposium On Corrosion Fundamentals

Fifteen lectures presented at a conference at the University of Tennessee in 1955 have been edited by Anton de S. Brasunas and E. E. Stansbury. The lectures deal with coatings for corrosion protection, high temperature corrosion, problems in steam power and industrial boiler plants, cathodic protection, plastics and plastic liners for protection, etc. The aim of the symposium was to consider fundamental factors underlying the causes and prevention of corrosion in a way which would contribute to industrial corrosion control practice. University of Tennessee Press, Knoxville, Tenn., 1956. 255 pp., $5.00.

Nomograms For The Analysis Of Frames

A presentation of a nomographical method of analyzing rectangular frames subjected to any system of concentrated loads, loads varying linearly, and moments due to concentrated forces. Three types of frames are dealt with: both columns fixed at the base, both columns hinged at the base, and both columns fixed at the base and hinged at the top. Complete formulas are given and examples are worked out by the author, J. Rygol. For convenience of use the nomograms are on separate sheets in a pocket at the back of the book. Concrete Publications Limited, London, S.W.1, England, 1957. 53 pp., $4.00.

Australia-New Zealand Conference On Soil Mechanics And Foundation Engineering, Proceedings

The proceedings of the Second Conference, 1956, made up of over twenty papers on various aspects of the theory of soil mechanics and the practice of foundation engineering. One group of three papers is devoted to the earth dam at Cobb Hydro-electric Power Development, another to studies of unsaturated soils. Subjects of some of the other papers include rapid consolidation tests; a direct shear machine with automatic recorders; shear strength of rockfill; pore pressure and shear strength tests on earth dam materials; selection of design values from shear test results; and protective systems for seepage control in earth dams. Published by The University of New Zealand and the New Zealand Institution of Engineers. Distributed by the Institution of Engineers, Australia, Sydney, Australia, 1957. 207 pp., £4.10.

Nuclear Power Reactors

Selected and arranged information from the papers presented at the Geneva Conference have been edited by James K. Pickard. After a discussion of the present outlook for heavy power production from nuclear sources the book covers basic facts on reactor design and construction and a comparison of various types as power producers. An extensive chapter is devoted to economic considerations, and detailed studies are presented of the different types of reactors. Published by the D. Van Nostrand Company, Inc., 120 Alexander Street, Princeton, New Jersey, 1957. 388 pp., $8.50.

Le Calcul Et La Verification Des Ouvrages En Beton Arme

A detailed treatment of methods of calculation and design for reinforced concrete structures, covering floors, foundations, roofs, retaining walls, girder bridges, and various minor details such as stairways. Brief information is also given on concrete materials and properties, on the placing of concrete, and on prestressed construction. The extensive use of numerical examples, graphic diagrams, tables, and monograms increases the practical value of this book by P. Charon. Published by Editions Eyrolles, Paris, France, 1957. 566 pp., 3,400 fr.

Symposium On Structural Sandwich Constructions, 1956

This symposium includes two papers on adhesive bonds, including metal-to-metal and metal-to-resin adhesion, and two papers on high-temperature testing. Other papers deal with sandwich in the design of helicopters, materials for architectural panels, non-destructive testing of sandwich structures, and shear strength of aluminum honeycomb. ASTM Special Technical Publication No. 201. Published by The American Society for Testing Materials, 1916 Race Street, Philadelphia 3, Pa., 1957. 103 pp., $2.75.

Manual Of Standard Practice For Detailing Reinforced Concrete Structures (ACI 315-57)

Combining previous manuals covering building and highway structures, this manual presents the latest improved methods and standards for preparing drawings for the fabrication and placing of reinforcing steel in reinforced concrete structures. Typical drawings for such structures as walls, stairs, circular tanks, rigid frame bridges, and retaining walls are shown to illustrate the use of the standards. Published by American Concrete Institute, P. O. Box 4754, Redford Station, Detroit 19, Mich., 1957. 86 pp., $4.00.

A Concise Guide To Plastics

This book by Herbert R. Simonds describes all known American commercial plastics, including those still in the laboratory stage. It covers the selection, use, and forms of plastics, with discussions of which ones best suit particular products. The information includes basic data on strength, properties, processes, production, and prices. Future trends and probabilities in plastics are also discussed, including new materials and production methods. Published by the Reinhold Publishing Corporation, 430 Park Avenue, New York 22, N. Y., 1957. 318 pp., $6.95.

Library Services

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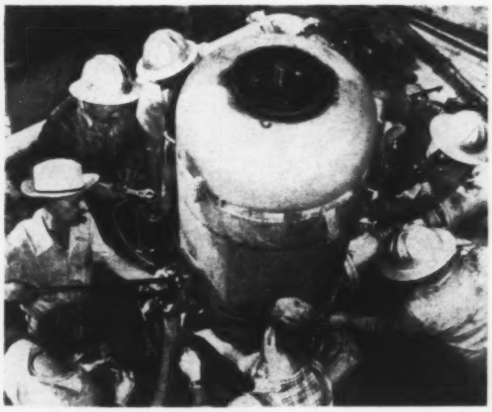

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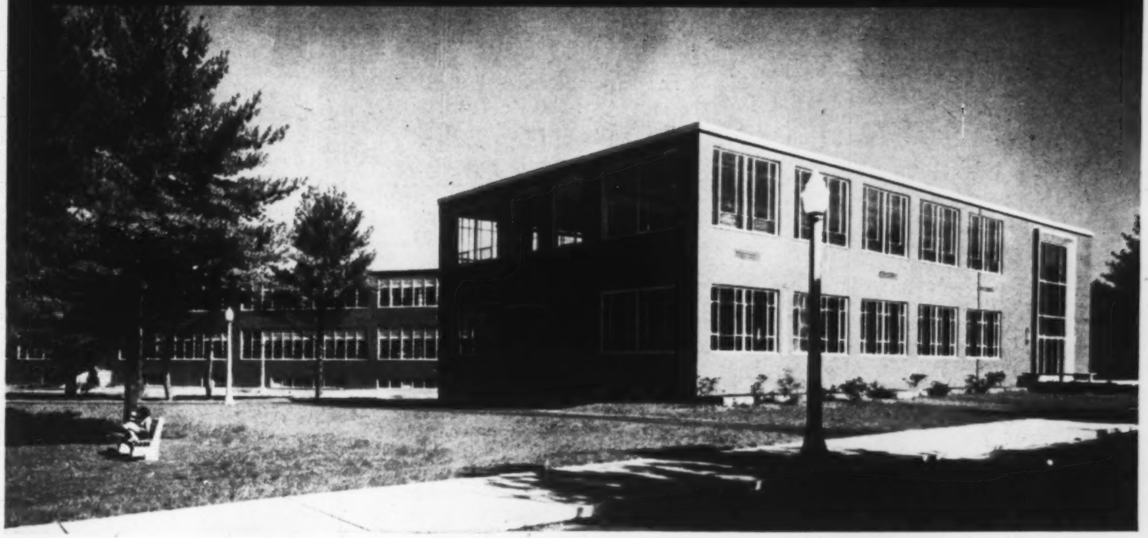

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"The many compliments we received on the masonry work are due to good masons and to Lehigh Mortar Cement."

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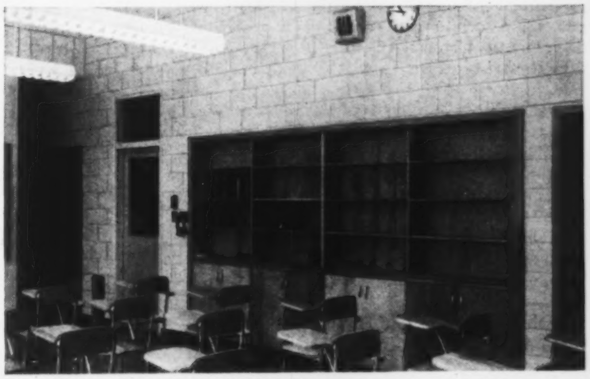

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DECEASED

Marghoob Ahmed (J.M. '57), age 27, engineer with the Corps of Engineers in Minneapolis, Minn., died there on October 30. Mr. Ahmed, a native of Karachi, Pakistan, received his M.S. in structural engineering from the University of Minnesota in 1956, and remained in this country to work for Ellerbe & Co., a St. Paul engineering firm. While in Pakistan, Mr. Ahmed received a special award for his excellent work.

Clark McKee Anderson (A.M. '36), age 54, design director for the District Public Works Office of the Tenth Naval District, Santurce, Puerto Rico, died there on November 20. Mr. Anderson began his professional career as a civil engineer in California. In 1942 he left the Los Angeles Floor Control District to go to Puerto Rico to work on construction of the drydock and other facilities at Roosevelt Roads. Later he worked as a civil engineer with the U. S. Navy at San Juan, P.R. and Guam, M.I.

William J. Campion, Jr. (A.M. '52), age 43, associate civil engineer in the Sacramento County (Calif.) Engineering Department, Sacramento, died recently. Prior to his work as associate engineer, Mr. Campion was resident engineer on highway construction work for the Division of Highways at Marysville, Calif., and assistant resident engineer in charge of structures, culverts and pavement work, for the Highway Division, at Sacramento. Earlier he served as an assistant area engineer with Porter-Urquhart, in Casablanca, Morocco.

Lothrop Crosby (A.M. '17), age 74, consulting engineer of Tacoma, Wash., died recently at his home. Mr. Crosby was best known for his work as assistant superintendent of the City of Tacoma Water Division, which he served for 26 years. He retired from municipal service in 1949 to act as a consultant on water supply problems. A graduate of the Sheffield Scientific School, Mr. Crosby began his career with the U. S. Reclamation Service in 1904, working on water supply engineering on the North Platte Project and the Big Wood Project in Idaho.

Earl D. Dryfoose (M. '30), age 60, traveling representative for the Illinois Division of Highways, died on November 12 in Springfield, Ill. A graduate of Purdue University, Mr. Dryfoose joined the Highway Division in 1919 as junior highway engineer, and served subsequently as assistant highway engineer, assistant bridge engineer, and engineer of roads, in charge of road design for highways throughout the state. He was a member of Tau Beta Pi, national honorary engineering fraternity.

William Easby, Jr. (M. '05), age 95, retired professor of engineering at the University of Pennsylvania and former consulting engineer, died on December 1. A graduate of Rensselaer Polytechnic Institute, Mr. Easby joined the faculty of the university in 1894, and for a time was head of the department of civil engineering. While at R.P.I., he designed and supervised construction of the department's hydraulic laboratory. Following his retirement from the university in 1919, Mr. Easby became a special lecturer at Drexel Institute of Technology and a consulting engineer for the Downingtown Water Works. He was one of the founders of the Philadelphia Section.

Maurice Gilmore (M. '21), age 79, prominent Metropolitan engineer and one-time regional director of the Public Works Administration in New York and ten other northeastern states, died in Bethesda, Md., on November 19. During his tenure as regional director, Colonel Gilmore directed the government's part in the tremendous construction work within his district. After resigning as director in 1940, Colonel Gilmore became public works commissioner and director of Defense Public Works in Washington, D. C. Later in his career, he served as engineer with Tippetts, Abbett, McCarthy, Stratton, New York City consultants. Colonel Gilmore studied at the Universities of Tulsa and Missouri, and at the Army War College in Washington, D. C. He was one of the few surviving members of the Rough Riders.

Frederick L. Hastings (J.M. '49), age 34, highway engineer with the National Park Service in San Francisco, Calif., died recently. Prior to his work with the Park Service, Mr. Hastings had been technical director with the San Joaquin County (Calif.) Housing Authority.

Stephen F. Holtzman (M. '10), age 84, retired structural engineer of Yonkers, N. Y., died there on November 19. For many years Mr. Holtzman was president of the Gunvald Aus Company, Inc., a New York City structural engineering firm that is no longer in existence. Notable among the firm's projects were the construction of the Woolworth Building and the United States Court House in New York City, the Supreme Court Building in Washington, and the Arkansas and Missouri State Capitols. During World War II, Mr. Holtzman worked for the War Production Board in Washington and New York.

Jack A. Killalee (A.M. '47), age 58, highway construction and materials engineer, died at his home in Burlingame, Calif., this November. Mr. Killalee had just returned from a two-year assignment in Beirut, Lebanon, for Tippetts, Abbett, McCarthy, Stratton, under contract with the International Cooperation Administration to assist in its long range demonstration and training program. As an adviser to the Lebanon Ministry of Public Works, Mr. Killalee helped plan a nine-mile highway between Beirut and Maameltin. Mr. Killalee had previously been sent abroad as one of eight experts chosen to represent the United States as part of the American Military Mission Aid to Greece and Turkey. Prior to his work for Tippetts, Abbett, McCarthy, Stratton, he was with the Bureau of Public Roads for 30 years as highway and construction engineer. Mr. Killalee was a graduate of the University of California.

J. A. Killalee

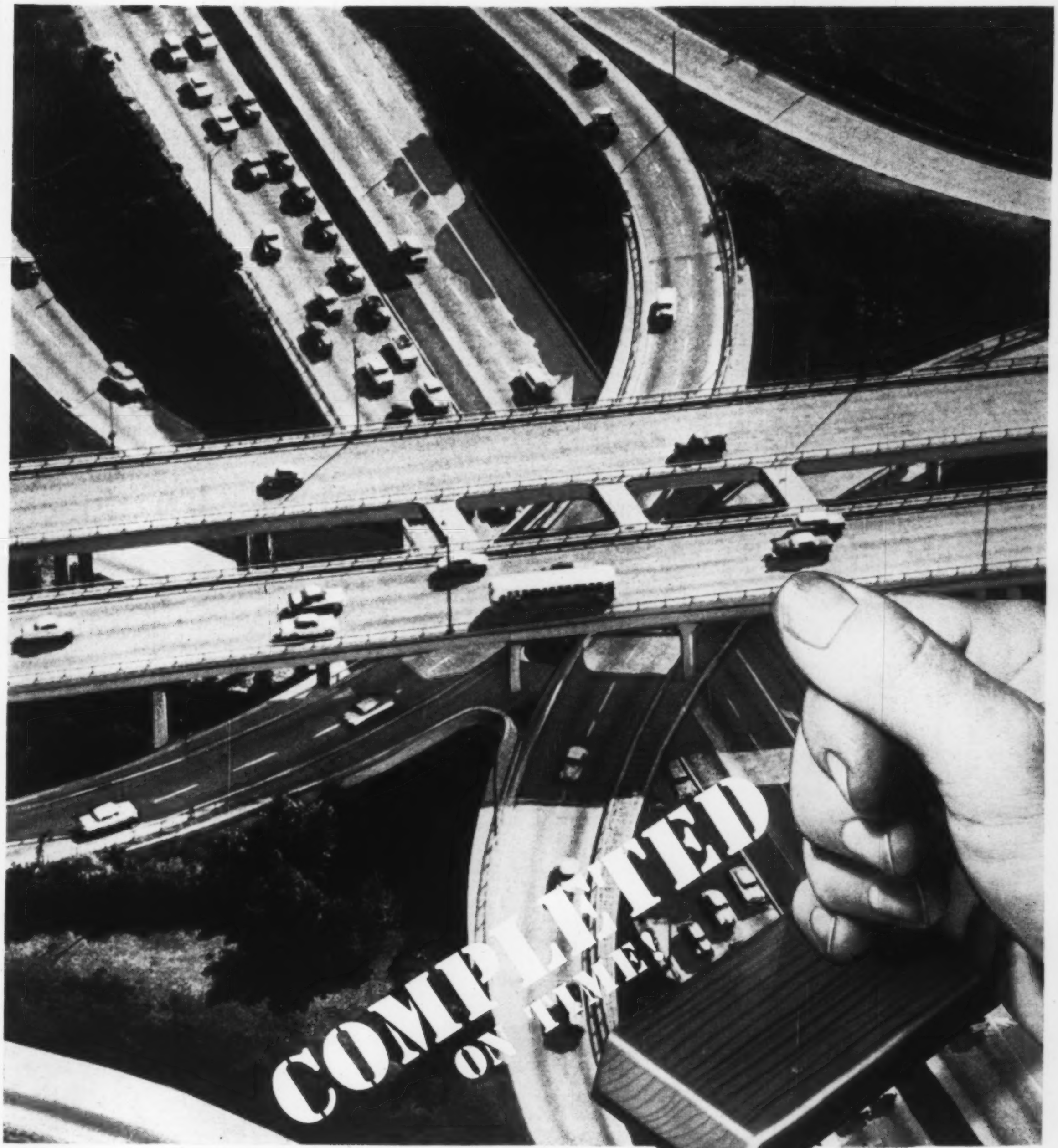
Gene V. Leete (J.M. '49), age 32, student in the University of California's Division of Civil Engineering at Berkeley, died recently. Before continuing his studies at the university, Mr. Leete served as junior sanitary engineer with the Division of Indian Research at Washington State College. Earlier he was a sanitary engineer with the Alaska Department of Health at Fairbanks.

Morrison B. Moore, Jr. (A.M. '37), age 53, engineer with the National Tube Company of Pittsburgh, Pa., died recently. Prior to his long tenure with the firm, Mr. Moore worked as assistant engineer for M. R. Scharff, and Morris Knowles, Inc., both of Pittsburgh. He was a graduate of Lafayette College.

Howard E. Moses (M. '18), age 82, director of the Division of Sanitary Engineering in the Pennsylvania State Department of Health, died on November 13 in Reading, Pa. A pioneer in the clean-streams program, Mr. Moses was the oldest full-time employee with the department, which he joined in 1908 as an assistant engineer. In 1937 Mr. Moses was appointed assistant chief sanitary engineer, and in 1942 was promoted to the position he held until his death. He was instrumental in the formation of the Ohio River Valley Water Sanitation Commission, which he served as chairman and member of the engineering committee. One of the founders of the Federation of Sewage and Industrial Wastes Associations, Mr. Moses served it for thirteen years as secretary and director, and was recently made an honorary member of the association. He graduated from Dickinson College and continued his education at the Johns Hopkins School of Hygiene and Public Health.

Tracy I. Phelps, Sr. (M. '24), age 75, retired assistant sanitation engineer for the Los Angeles County Department of Sanitation, died on October 18. Mr. Phelps began his work with the department in 1925. In his last capacity, he directed the work of a large corps of engineers, designers and draftsmen, and himself designed some 30 miles of the city's domestic water supply system. Prior to

(Continued on page 108)



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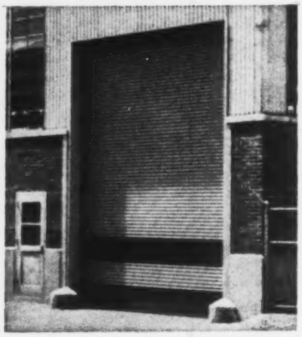

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Deceased

(Continued from page 106)

his work with the department, he was with the U.S. Reclamation Service for 20 years, as engineer on the Minidoka Project in Idaho and as project manager of the Ochoco Irrigation Project, Prineville, Ore. Mr. Phelps was a graduate of the Missouri Schools of Mines.

Somers H. Smith (A.M. '16), age 70, retired railroad engineer with the Chicago, Milwaukee and St. Paul Railroad, died in Elmhurst, Ill., on October 29. Mr. Smith, who devoted most of his professional career to railroad engineering, retired from the C.M. & St. P. at the age of 65. Since then he had been structural engineer with the Macdonald Engineering Company of Chicago.

Ernest Alonzo White (M. '52), age 69, retired Pierce County Engineer, died recently in Tacoma, Wash. Mr. White had been county engineer and assistant county engineer for more than 41 years. Early in his career he served the Washington State Highway Department.

Frederick C. Woermann (M. '10), age 80, chairman of the board of the Woermann Construction Company, St. Louis, Mo., died there in October. Mr. Woermann founded his general contracting firm in 1913, and was president and treasurer until 1953 when he became chairman of the board. Active in civic affairs, he served on the committee that wrote the 1914 city building code, and on a citizens' advisory committee which helped draft the 1950 zoning ordinance. A graduate of the Washington University School of Engineering, Mr. Woermann received a citation from the university for "outstanding achievement." He was a past-president of the St. Louis Section.

Oscar T. Yates (A.M. '37), age 61, construction engineer of Cincinnati, died there on October 18. Mr. Yates had been employed in the office of the Division Engineer, Ohio River Division, U. S. Army Engineers for the past 22 years. Mr. Yates was educated at the University of Washington.

Positions Announced

City of Ann Arbor. Vacancy now exists for Superintendent of Utilities to take charge of management, maintenance, and operation of city water works. Major expansion program underway. Experienced engineer required. Salary open, includes all fringe benefits. Write Guy C. Larcom, Jr., City Administrator, City Hall, Ann Arbor, Michigan.

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Refinery Engineer, J.M. ASCE; B.S.C.E.; 31; 6½ years' well rounded experience in oil refinery maintenance and construction work. Conducted inspection, corrosion studies; 2 years' pipeline and related POL construction. Knowledge Spanish. Desires position with oil company or on construction of petroleum facilities. Location: West, South United States or Foreign. C-284.

Civil-Sanitary Engineer, A.M. ASCE; B.C.E. (Sanitary Option); 33; 5 years' university teaching fluid mechanics, sanitary design; 2½ years' municipal public health work; 2½ years' municipal engineering; 2 years' research in sanitation. Graduate work in sanitation and structures. P. E. N. Y. and N. J. Also engaged in consulting work. Location: Open. C-285.

Project Engineer, J.M. ASCE; B.S.C.E.; 28; registered; 7 years' varied engineering and production experience in mining and chemical industries. Wants responsible plant engineering or administrative position. Cost conscious. Can supervise men. Will travel half time. Some Spanish. Prefer western U.S. or foreign location. C-286.

Structural Engineer, J.M. ASCE; B.S.C.E.; 29; 8 years' diversified experience including 2½ years' field engineer on heavy construction and slip-formed construction; 2 years' structural engineer for engineer-architect. Location: Middle Atlantic. C-287.

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Please submit resume giving complete employment history, education, age and salary requirements.

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BOX 287

Professor, Civil Engineer; M. ASCE; 54; B.S. and M.S. structural and hydraulic engineering; 5 years of professorship and over 20 years of engineering experience on planning, design and construction of hydraulic engineering work; prefer teaching, research or supervising work. C-288.

Construction Supervisor for Architect-Engineer, M. ASCE; 61; registered, N. J.; retired Col. USAF and retired from Federal Civil Service; formerly Chief, Operations Division, District Office, Corps of Engineers, and Deputy Branch Chief, Engineer Office for major heavy, building and engineering construction program budgeted for $200,000,000 plus per annum. Prefer location Pittsburgh-Youngstown-Wheeling area but will consider elsewhere. 42 years' experience including 7 years' sales and contract negotiation. C-289.

Highway Engineer, J.M. ASCE; B.S.C.E.; 31; 3½ years' experience in highway construction, including 2 years as project engineer on a section of a midwest turnpike; 3 years' experience in highway design as chief designer for an engineering firm. Location: Midwest or western U.S. C-290-884-Chicago.

Civil Engineer, J.M. ASCE; B.S.C.E.; P.E., N. Y.; 35. 10 years' civil, structural design primarily for multi-plant chemical and industrial manufacturer. Includes new plants and modification to existing facilities. Reinforced concrete, steel, sewer systems, plant layout, plumbing, heating, surveying, economic studies, estimating, inspection, report writing. C-291.

Civil Engineer, A.M. ASCE; B.Sc. (Engineering); A.C.G.I.; M.I.C.E.; 49; desires responsible senior appointment, starting about spring of 1958; varied experience for 28 years as civil engineer in Britain and elsewhere, mainly with government, also with consultants and contractors. Presently located in northern Ireland. Location: Australasia or Pacific. C-292.

Civil Engineer, Scottish, A.M. ASCE; A.M. Institute of British Engineers; 34; 11 years' experience in consultants' offices and government departments on the design and supervision of roads, sewers, water supply and industrial building construction including reinforced concrete and city planning. Also 3 years with a State Highway Authority through Fulbright Scholarship; at present resident engineer on multimillion rehabilitation program for a U.S. company in Scotland. Seeking position of responsibility, co-ordinating or directing projects. Willing to travel. C-293.

Sales Engineer or Manager, Product Manager, J.M. ASCE; B.S.C.E.; 28; 5 years' experience in engineering and sales work. Trained in curtain wall and heavy construction products. Location: Southwest or Western area. C-294-9467-Detroit.

Civil and Sanitary Engineer, A.M. ASCE; 33; M.S.C.E.; registered P.E., N. Y. and N. J. 11 years' comprehensive experience in water supply, sewerage and drainage facilities investigation, design and construction—U.S. and overseas; public, industrial, and military works. Knows Spanish. Available as project engineer or for other supervisory assignment. Location: U.S. or Foreign. C-295.

Civil Project Engineer, M. ASCE; M.C.E. (Sanitary); 40; 14 years' experience in fields of water supply and waste water disposal, research and development, design, writing reports, sales, and construction; also 3 years' civil engineering experience. Location: East or West Coast, or Foreign. C-296.

Consultant, J.M. ASCE; B.S.C.E.; 9 credits post-graduate work; 26; 1 year varied field experience reinforced concrete and framed steel structures; 4 months' field engineer for construction company; surveyor for city engineer and for public utility on earth fill dam; 2 years' assistant professor U.S. Naval Academy, fluid mechanical, thermo, aerodynamic. Location: West, Midwest, East. C-297.

Positions Available

Instructor to Associate Professor in Sanitary Engineering; B.S. degree with an M.S. preferred; some teaching experience desired. Salary, $4500-$6000 for 9 months. Position available either February 1958 or September 1958. Location: Southwest. W5500.

Civil Engineer, Chief; graduate; 45-65; Minimum of 15 years' experience in building design, layout and construction and with substantial experience in sanitation systems, ability to advise on design of improvements to existing water supply systems in municipalities. Will review proposed designs, layouts and specifications of structures, equipment, piping and related items for economy and feasibility; check engineering programs, review contracts, etc. Salary commensurate with past earnings and experience; transportation expenses and quarters allowance paid. Climate subtropical. Duration, approximately 9 months with possibility of extension. Location: Far East. F5510.

Sanitary and Hydraulic Engineer, civil graduate, with at least 15 years' supervisory design and project engineering experience covering water supply sources, distribution systems and sanitary facilities. Single status. Salary, $13,000 a year U.S. base plus 25% overseas differential for time spent outside of the U.S. Travel, transportation, quarters and subsistence provided. Company pays placement fee. Location: 9 months in Korea; 3 months in U.S. F5544.

Highway Engineer, graduate engineer, with about 15 years' experience in all phases of highway engineering. Will take complete charge and responsibility without supervision of the project consisting of a route selection study and report for a major highway. Duration: 3 months in Korea, 1-2 months in the U.S. Single status. Salary open. Travel, transportation and subsistence provided. F5564.

Civil Engineers with training, experience and interest in water resources development for a state natural resources council. Location: Midwest. W5565.

Civil Engineers experienced in drainage and sewerage design. Salary open. Position permanent. Location: Massachusetts. W5569.

Soils Engineer with civil degree and at least 15 years' experience, to join construction supervisory staff of a large, long established company with extensive long-range expansion program. Will supervise placement and inspection of graded materials on rock fill earth core dam 300 feet high. Salary open. Location: Southeast. W5593.

Instructors to teach college level courses preparing students for the building construction industry. College degree preferred but satisfactory experience will be considered. Location: South. W5611.

Teaching Personnel. (*a*) Instructor in civil engineering; M.S. not required. (*b*) Assistant or Associate Professor with interest in sanitary engineering; M.S. or Ph.D. required. Positions available February 1, 1958 or September 1, 1958. Location: West. W5623.

Planning Director, graduate civil, with executive ability, to direct a large county planning project. Permanent. Salary, $10,500 a year and up. Location: New York suburban area. W5626.

Executive Director to carry out public relations and administrative duties for an engineering society. Engineering background preferred. Salary open depending upon qualifications. Location: Midwest. W5632.

Project Manager, graduate civil; 40-55; with 10-15 years' supervisory experience on highway and highway bridge construction. Will head up division dealing with foreign road contracts. Headquarters, New York, N. Y., considerable foreign travel. Salary commensurate with past experience. W5636.

Associate Professor for Department of Civil Engineering, to teach surveying and photogrammetry. Will also be in charge of surveying instruction and will be responsible for development of laboratory facilities in photogrammetry and aerial surveying. Salary, on a twelve-month basis, $7500. Location: South. W5654.

Construction Engineer with a minimum of 5-8 years' experience, preferably, but not limited to, mechanical, civil, structural or chemical engineering. Experience should be on construction projects concerned with industrial, metallurgical and/or chemical plants. Must be capable of assisting superintendent in all phases of field engineering, construction of buildings and installation of facilities and equipment for industrial plants or major additions. Location: upstate New York. W5656.

Transit Administrative Engineer for large eastern city. Engineering degree. with 10 years of responsible experience in planning, design, and construction of transit facilities including experience in administrative capacity, experience in operation of transit system and in supervision of construction contracts. Will be responsible for planning, directing and coordinating transit design, construction and operation; development of long-range policies and programs for extensive improvements and extensions to rapid transit systems. Location: Pennsylvania. W5660.

Construction Engineers with at least 10 years' multi-story fireproof apartment and commercial building experience. (*a*) Project Engineer; 35-55; with estimating, planning, subcontracting, negotiating and cost experience. Salary, $9100-$10,400 a year. (*b*) Chief Engineer, civil graduate preferably P.E. license; 50-60; with at least 15 years' experience. Salary, $15,000-$20,000 a year. (*c*) Senior Estimator to prepare figures from preliminary plans and sketches. Salary, $7800-$10,400 a year. (*d*) Construction Superintendent to take charge of construction of apartments and commercial buildings. Salary, $11,700-$13,000 a year. (*e*) Project Coordinator to supervise electrical and mechanical construction and installations. Salary, $13,000-$15,600 a year. Location: New York area. W5668.

Chief Project Engineer with at least 10 years' process industry design and construction experience, to undertake full responsibility of erecting plant for manufacture of lead tetraethyl. Salary open. Headquarters: New York, N. Y. W5680.

Planning Engineer, under 35; preferably civil graduate. with experience in highway and urban traffic planning. Some experience in design in the civil engineering field desirable. Salary open. Location: South. W5683.

Hydraulic and Sanitary Engineers, graduate engineers; 30-40; with 2 or more years' in flood control, drainage, structural design or sanitary engineering and a knowledge of engineering and technical writing. Will assist in the preparation of technical literature on dams, flood control, culvert and drainage structures or sanitary, water and sewage plants; make inspection of projects under construction and assist field force in promoting use of concrete for project. Must have good personality; travel. Salary open. Company will pay placement fee. Location: Chicago. C-6600.

Applications for Admission to ASCE, Nov. 4-Nov. 30

Applying For Member

George Parke Adair, Ridgewood, N. J.
Louis Jacob Daigre, Jr., Alexandria, La.
Cornelis deNeeff, Oakland, Calif.
Thomas Barnes Donoho, San Antonio, Tex.
William August Dosr, Wilmington, Del.
Robert Lick Gamer, New Delhi, India.
Sidney Parker Gilbert, New York, N. Y.
Robert Henderson Keyser, Carroll, Ohio.
Miles Alexander Lamb, Chicago, Ill.
James Latham, Prince Rupert, B. C., Canada.
Orestes Paul Lazarides, New York, N. Y.
Toivo John Nelson, Sacramento, Calif.
Tien-Yuan Peng, North Borneo, China.
Lorin Allen Presby, New York, N. Y.
Ralph Edward Scott, Cleveland, Ohio.
George Leon Server, Colorado Springs, Colo.
David Francis Smallhorst, Austin, Tex.
David Montgomery Smallwood, Philadelphia, Pa.
Kenneth Gordon Taylor, Greenville, S. C.
Stanley Harold Van Greenby, New York, N. Y.
Daniel Webster, Portland, Me.
Galyn Augustus Wilkins, Phoenix, Ariz.
Iftikhar Ali Zafar, Karachi, Pakistan.

Applying For Associate Member

Franklin Harding Andrew, Swarthmore, Pa.
Edmund Serle Bell Jr., Coshocton, Ohio.
James Leman Birchim, Independence, Calif.
Carl Frederick Bolsen, Cincinnati, Ohio.
Richard Peter Braun, Minnesota, Minn.
Moses Brodetzky, Brooklyn, N. Y.
William Gordon Burke, China Lake, Calif.
Paul Richard Chevalier, Loudonville, N. Y.
Yasef Danon, Istanbul, Turkey.
Fenrick Rudolph DeFour, Trinidad, B. W. I.
Carroll Scott Delaney, Denver, Colo.
Jerry Stanley Dobrovolny, Urbana, Ill.
Ahmed Mehdi El-Dujaily, Denver, Colo.
Saul Nathan Garfinkle, New York, N. Y.
James William Gilkeson, Jr., Harrisonburg, Va.
Charles William Harter, College Place, Wash.
Frederick William Hauptle, Jr., Lansdowne, Pa.
Thorwald James Hendricksen, Tacoma, Wash.
John Lamp, Hinsdale, Ill.
Ernest Paul Miles, Washington, D. C.
Dimiter Mitschowetz, Summit, N. J.
Henri Perrin, Palisades Park, N. J.
Elmer Joseph Pollock, Havertown, Pa.
Carl Ernst Reinhardt, Honolulu, T. H.
Miguel Angel Rivera-Bisbal, San Juan, P. R.
Raymond John Roy, Taunton, Mass.
Amarasinghe A.D.O.P. Saparamado, W. Lafayette, Ind.
Jack Maurice Schick, Lansing, Ill.
Roy Steven Sherer, Atlanta, Ga.
Merle Erwin Simonsma, Sacramento, Calif.
Fred L. Sommer, New York, N. Y.
Humberto Soto, New York, N. Y.
Walter Cecil Spain, Miami, Fla.
John Stavrakas, Mosul, Iraq.
Wallace J. Stephenson, Richfield, Utah.
Hajime Tanaka, Honolulu, Hawaii.
Gordon George Townsend, Towson, Md.
Arthur Frank Vondrick, Chicago, Ill.
Ronald Chun Chieh Wang, Singapore, China.
Rudolph Wrubel, Iselin, N. J.
Ned Wilford Young, Aliquippa, Pa.

Applying For Junior Member

Raymond Charles Belter, Buffalo, N. Y.
Robert Leslie Goodell, Elkins Park, Pa.
William Edward Greene, Jr., Needham Heights, Mass.
Aage Raymond Holm, New York, N. Y.
Lewis Palmer Lane, II, Long Beach, Calif.
Rauni Oscar Lindcross, Jr., Baltimore, Md.
Shamsul Mulk, Bannu, W. Pakistan.
George Nasr, Bethlehem, Pa.
Carl Herbert Pohler, San Francisco, Calif.
Gopal Varada Rajan, Baltimore, Md.
Luis Guillermo Restrepo, Columbia, South America.
William Whitaker Sayre, Denver, Colo.
Charles William Stoyer, Greenville, Pa.
Harold Butler Tennant, Fort Sam Houston, Tex.
Jackson Eyres Thomas, Montgomery, Ala.
Gilbert Bruce White, Overland Park, Kans.
John Francis Wilkinson, Santa Ana, Calif.

[*Applications for Junior Membership from ASCE Student Chapters are not listed.*]

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Non-ASCE Meetings

American Concrete Institute. Annual Convention at the Morrison Hotel, Chicago, Ill., February 24-27. For information write the American Concrete Institute, P. O. Box 4754, Redford Station, Detroit 19, Mich.

American Congress on Surveying and Mapping and American Society of Photogrammetry. 1958 ACSM—ASP Consecutive Meetings and Co-Exhibit, Washington, D. C., at the Shoreham Hotel, March 23-29. For information write ACSM—ASP, 1515 Massachusetts Avenue, N.W., Wash. 5, D. C.

American Institute of Chemical Engineers. Fourth Nuclear Engineering and Science Conference at the Chicago International Amphitheatre, Chicago, Ill., March 17-21. For information contact Joel Henry, Congress Manager, American Institute of Chemical Engineers, 25 West 45 Street, New York 36, N. Y.

American Institute of Electrical Engineers. 1958 General Winter Meeting at the Hotel Statler and Sheraton-McAlpin Hotel, New York, N. Y., February 3-7. Details from AIEE, 33 West 39 Street, New York 18, N. Y.

American Road Builders Association. National Convention at the Sheraton-Park Hotel, Washington, D. C., January 20-23. For information write ARBA, World Center Building, Washington, D. C.

American Society for Engineering Education. 1958 College-Industry Conference at the University of Michigan, Ann Arbor, Mich., January 30-31. Details from University of Michigan, College of Engineering, 255 West Engineering Building, Ann Arbor, Mich.

American Society of Heating and Air-Conditioning Engineers. Sixty-fourth Annual Meeting at the Penn-Sheraton Hotel, Pittsburgh, Pa., January 27-29. Details from the Society, 62 Worth Street, New York 13, N. Y.

Georgia Institute of Technology. Seventh Georgia Highway Conference at Georgia Tech, Atlanta, Ga., February 24-25. Contact Richard Wiegand, Director, Short Courses & Conferences, Georgia Institute of Technology, Atlanta, Ga.

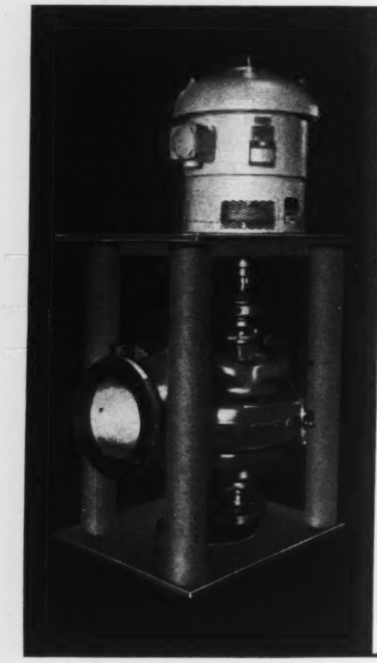
National Military-Industrial Conference. Fourth Annual Conference at Conrad Hilton Hotel, Chicago, Ill., February 17-19. Information from Charles Heath, 140 South Dearborn Street, Chicago 3, Ill.

National Society of Professional Engineers. Spring Meeting at Michigan State University, East Lansing, Mich., February 13-15. Inquiries to Kenneth E. Trombley, National Society of Professional Engineers, 2029 K Street, N.W., Wash. 6, D. C.

University of California. Tenth Annual California Street and Highway Conference, co-sponsored by the University Extension and the University's Institute of Transportation and Traffic Engineering at the Los Angeles campus of the University of California, January 29-31. Information from the University.

University of Illinois. Forty-fourth Annual Illinois Highway Engineering Conference, February 25-27. Tenth Annual Illinois Traffic Engineering Conference, February 27-28. Both at the University's Urbana campus. Information from the university.

University of Utah. Nineteenth Annual Highway Conference sponsored by Department of Civil Engineering, at University of Utah, Salt Lake City, Utah, March 3-5. Information from Grant K. Borg, Head, Department of Civil Engineering, University of Utah, Salt Lake City, Utah.



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Typical vertical installation of Wheeler-Economy Single Stage, Double Suction Pump. These High-Head Pumps, usually installed horizontally, can easily be mounted vertically, with a 50% saving in floor space. Motor here is located directly over Pump, but it could have been mounted on a floor some distance above Pump.

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News of Engineers

(Continued from page 24)

Benson Wood

Benson J. Wood has been elected vice-president in charge of the Highway Engineering Division of Harley, Ellington and Day, Inc., Detroit architects and engineers. For the past two years, Mr. Wood has been project administrator of the firm's highway and bridge department, and supervisor of industrial work. He has been connected with the firm since 1946. Mr. Wood recently served as president of the Michigan Section.

Joe Patrick has opened an office for the practice of structural and civil engineering in Roebuck, S. C. He was formerly head design engineer for the Harwood Beebe Company in Spartanburg, S. C.

H. E. Helmboldt, Colonel, Corps of Engineers, U. S. Army, has been assigned to Headquarters, Continental Army Command, Fort Monroe, Va., for duty in the engineer section. Since August 1956 Colonel Helmboldt has been resident engineer for the rehabilitation and construction project recently completed at the Alabama Ordnance Works, Childersburg, Ala.

Thomas G. Reynolds announces the formation of Reynolds-Bohna & Co., Inc., consulting & design engineers, with offices at 1617 Pennsylvania Boulevard, Philadelphia, Pa. Mr. Reynolds has been executive engineer for the Catalytic Construction Co. in that city.

Maurice L. Albertson, Professor of civil engineering at Colorado State University, has been appointed to the newly created position of director of the Colorado State University Research Foundation. The director's job will be coordinate with that of Dean of the Faculty and Director of the Colorado Agricultural Experiment Station. Dr. Albertson's work will embrace all activities from negotiation of initial contracts to coordination of foundation projects with the regular research and teaching programs of the university.

Thornton E. Smith, former treasurer of Kuhn, Smith & Harris, Inc., building contractors of New York City, has been elected president of the firm. Before joining the company in 1955, Mr. Smith was associated with Fraser, Brace and Company, Engineers, and with the Industrial Engineering Company, Builders, both of New York City.

Daniel V. Terrell, ASCE past-president and dean emeritus of the University of Kentucky's College of Engineering, was recently honored by his colleagues at a testimonial dinner. In recognition of his long service to the school and in tribute to an outstanding educator, Dean Terrell's portrait was unveiled during the evening and presented to the university.

William G. Murphy has been named director of the engineering mechanics department at the Marquette University College of Engineering in Milwaukee. He has been associate professor of civil engineering since 1953, and a member of Marquette's faculty since 1949.

Darrell A. Veach, formerly of Lexington, Ky., has been appointed field engineer for southwestern Indiana by the Portland Cement Association. His headquarters will be in Evansville.

C. B. F. Brill

Clinton B. F. Brill, partner in the firm of DeLeuw, Cather and Brill, New York City, has been named chairman of the New York State Thruway Authority. In making the appointment, Governor Harriman said that Mr. Brill would also act as "assistant to the governor in connection with the state's construction program, including buildings for state institutions as well as highways." Mr. Brill's record of public service dates back to 1934, when he was on the staff of the Triboro Bridge Authority. Later he served as assistant liaison engineer for the New York World's Fair, and worked on the design and construction of the New York International Airport.

David M. Greer, of Greer Engineering Associates, Montclair, N. J., and **G. Kenneth Jewell,** consulting soils engineer and formerly soils engineer for the Ohio Turnpike Commission, have formed a partnership for the practice of soils and foundation engineering, under the name Greer-Jewell & Associates. The new firm's office and laboratory are at 195 Chittenden Avenue, Columbus, Ohio.

Carl F. Thomas, secretary and chief engineer of the Spokane, Portland and Seattle Railway Company, has retired after 43 years of service. Mr. Thomas has worked successively as draftsman, assistant engineer in the bridge department, resident engineer, and principal assistant engineer. **Harland F. Moy** will succeed Mr. Thomas as secretary and chief engineer. Mr. Moy has served the railway in many capacities since joining it in 1937.

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New Publications

Atomic energy . . . "What's Available in the Unclassified Atomic Energy Literature" is a brief description of reports released by the Atomic Energy Commission, its contractors and other sources. For information write the U. S. Atomic Energy Commission, Technical Information Service Extension, Oak Ridge, Tenn.

Water and sewerage projects . . . Advance plans for water and sewerage construction projects, partially financed by the federal government, are reviewed in a new bulletin. Copies of "Water and Sewerage Projects in the Advance Planning of Non-Federal Public Works Programs" are available at the Sales and Distribution Branch, Office of Administrative Operations, U. S. Department of Commerce, Wash. 25, D. C., and at the Department of Commerce field offices. The price is 25 cents.

U. S. waterborne commerce . . . Publication of a report, entitled "Waterborne Commerce of the United States, Calendar Year 1956, Part 3, Waterways and Harbors, Great Lakes," is announced by Brig. Gen. Louis J. Rumaggi, Division Engineer at Chicago, Ill. Copies at 70 cents each may be purchased from the U. S. Army Engineer District, Lake Survey, 630 Federal Building, Detroit 26, Mich.

Charting steel's progress . . . A graphic facts report on the iron and steel industry has been released in its 1957 edition by the American Iron and Steel Institute. The booklet deals with raw materials, iron and steelmaking capacity, expanding production, distribution, labor conditions, and the economy of the industry. Copies are available from the American Iron and Steel Institute, 150 East 42 Street, New York 17, N. Y. at 50 cents each.

Steel series . . . The newest section of the American Iron and Steel Institute's "Steel Products Manual" is off the press. This section, on "Hot Rolled Carbon Steel Strip," covers tolerance, method of inspection, and chemical analysis. For information write the Institute, 150 East 42 Street, New York 17, N. Y.

Highway statistics . . . A historical summary of factual information dealing with highways, their use and financing, is made available by the Bureau of Public Roads. The 150-page bulletin may be purchased from the Superintendent of Documents, Government Printing Office, Washington 25, D. C., at $1.00 a copy.

Filler metal comparison charts . . . A comprehensive set of welding rod and electrode comparison charts has been published by the American Welding Society. The 24-page booklet contains brands, manufacturer's names and AWS-ASTM specifications. Copies at $2.00 postpaid, may be obtained from the Society, 33 West 39 Street, New York 18, N. Y.

Construction safety . . . Two manuals have been added to the growing list of industrial safety guide books, published by the Accident Prevention Department of the Association of Casualty & Surety Companies. "Power Line Safety Manual" deals with the area of utility company work which is responsible for almost two-thirds of all fatal accidents in the electric light and power industry. The second booklet, "Your Guide to the Safe Use of Powered-Actuated Tools," discusses the hazards inherent in procedure and equipment, and suggests means of avoiding them. For information write the Accident Prevention Department, Association of Casualty and Surety Companies, 60 John Street, New York 38, N. Y.

Water power in Alaska . . . The Geological Survey has released to open file the results of research in potential hydroelectric power in the Juneau, Alaska, area. The preliminary report is available for inspection at offices of the Geological Survey in Washington, D. C.; San Francisco and Los Angeles, Calif.; Tacoma, Wash.; Denver, Colo.; Juneau, Anchorage, and College, Alaska.

Screw-thread standards . . . Recent work of the Interdepartmental Screw Thread Committee, sponsored by the Departments of Defense, Army, Navy, Air Force, and Commerce, is reviewed in a new publication entitled "Screw-Thread Standards for Federal Services." The 214-page handbook is the first of three volumes to be published by the National Bureau of Standards. Copies, priced at $1.25 each, may be ordered from the Superintendent of Documents, U. S. Government Printing Office, Washington 25, D. C.

Concrete highways . . . Practical procedures and technical information concerning use of Portland cement concrete in highway construction are contained in a new booklet of the University of Wisconsin Extension Division. The 134-page report "Portland Cement Concrete in Highway Egineering," is designed for both the construction worker and the highway engineer. It is available from the Extension Bookstore, University of Wisconsin, Madison 6, Wis., for $2.50.

Iron and steel . . . "The Making, Shaping and Treating of Steel" is a complete, one-volume work now published in a seventh edition by the United States Steel Corporation. The illustrated 932-page text offers a comprehensive summary of present-day theory and practice in iron and steel production. Copies, priced at $7.50 each, may be obtained from United States Steel, Office Service-Stores, 525 William Penn Place, Pittsburgh 30, Pa. The price to students of accredited educational institutions is $5.00 a copy.

Information received before March 15,
1958, will appear in the 1958 Directory

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Title or Position ....
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General Chairman
Stanley Engineering Co.
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Chicago 4, Ill.

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Pipeline Luncheon	....
Highway Luncheon	....
Cocktail Party	....
Tuesday, Feb. 25	
Division Luncheon	....
Women's Luncheon	....
Wednesday, Feb. 26	
Membership Luncheon	....
Dinner-Dance	....
Thursday, Feb. 27	
Research Luncheon	....
Women's Brunch	....
Smoker	....
Friday, Feb. 28	
Power Trip	....
Laboratory Trip	....
Public Works Trip	....

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To avoid duplication of effort and to bring the hydraulics engineer a definitive list of available translations of literature on hydraulics, the Committee on Research of the Hydraulics Division has prepared "A List of Translations of Foreign Literature on Hydraulics." This material is available as ASCE Manual 35—the latest of a renowned series of authoritative publications on civil-engineering subjects. This Manual can be ordered by clipping this coupon and remitting as indicated below.

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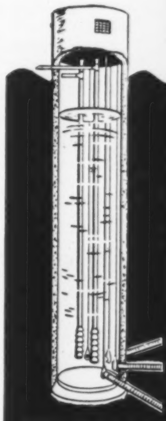
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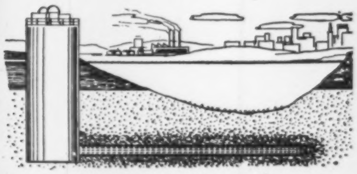
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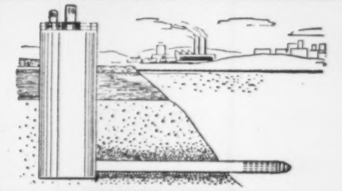
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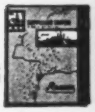

RANNEY® METHOD

Ranney Method Water Supplies, Inc.
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Associated With
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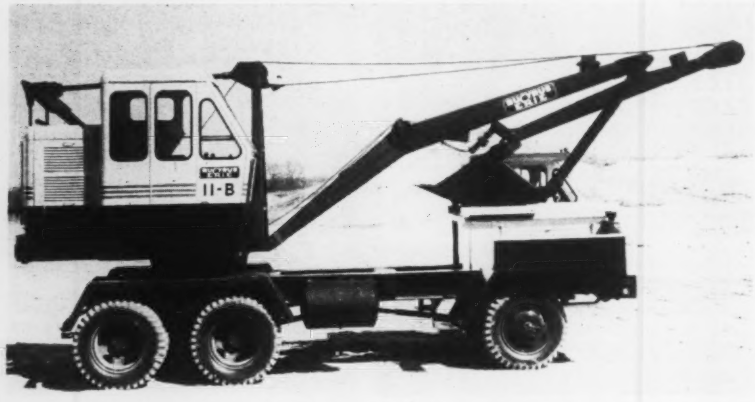
Dept. CI-

EQUIPMENT, MATERIALS and METHODS

NEW DEVELOPMENTS OF INTEREST AS REPORTED BY MANUFACTURERS



11-B Transit Crane-Excavator

TIME-SAVING ACCESSIBILITY, low cost maintenance, versatile crane-excavator service, and fast, rubber-tired mobility—these are some of the significant advantages describing a new model transit machine. The 11-B, designed simply and compactly to provide a low cost yet quality product, is readily convertible from a 10-ton lifting crane to a dragline, clamshell, hoe, or shovel to handle a variety of jobs. It is mounted on a modern 6-wheel drive carrier, which provides up to 47-mph speeds. The new carrier, the manufacturer states, is designed for all-round mobility to cut high operating costs on busy scattered-job schedules. Several new features incorporated in the design are tailored for contractors faced with low budget or high overhead problems. The emphasis is on ease of maintenance and quick accessibility. For example, the hoist shafts, horizontal transmission shaft, horizontal swing shaft, and swing circle are unit or bench assemblies, each designed to permit quick service or easy replacement as a unit. **Bucyrus-Erie Co., CE-1, South Milwaukee, Wisconsin.**

Liquid Adhesive

AN UNEXPECTED RESULT OF a routine test in one of the nation's large research laboratories has led to the development of a new liquid adhesive so unique in its combination of rapid set-time and high strength that it promises to have widespread influence on industrial design. How unique can be demonstrated by placing one drop of this colorless liquid on one end of a 2-in. steel rod. Press the end of a similar rod against this surface and hold for a few seconds. With eye bolts attached to opposite ends of this assembly, place it between a crane hook and a lifting harness. Within 5-min, this one drop will easily support the weight of a 200-lb millwright. Meantime, the bonding forces between the molecules within this drop are continuing to develop rapidly. Within 30-min, let's drive one of the largest automobiles on the market onto the lifting harness and fill it with passengers. A signal to the crane operator lifts it smoothly off the ground. One drop—30-min.—5000-lb. If the adhesive is permitted to set for 48-hour, three identical cars could be lifted simultaneously. All this is accomplished without the necessity for heat, pressure, evaporation of solvent, or long curing times, whereas, other high-strength adhesives require one or more of these conditions for successful bonding. Resulting from the polymerization of a cyanoacrylate monomer, the adhesive action works well with a wide variety of materials including metals, glass, wood, ceramics, and rubber. **Eastman Chemical Products, Inc., CE-1, Kingsport, Tenn.**

Portable Microwave Instrument

THE TELLUROMETER, AN ELECTRONIC device for measuring long distances accurately is now being used extensively. Accuracies, for experienced crews, are 1:200,000 (2 to 3-in. for 20 to 30-mi) when compared with established triangulation stations. Range is 500-ft up to 20 or even 40-mi. A master and remote unit is required, each weighing 57-lb, which must be supplemented by a 6-volt storage battery. Thus it is easy to pack in to remote locations. A reasonably direct line of sight is required but brush or light woods can be passed. Distance between points is measured. A surveyors aneroid is used to determine difference in elevation for horizontal length determination. The unit includes a built-in radio telephone so you can still contact the man at the other end even if he cannot be seen. The Tellurometer can find the remote instrument within a cone of 10-deg. Conversation is limited within the 10-deg cone so has some privacy on its assigned frequency. **Tellurometer, Inc., CE-1, 1346 Connecticut Ave. N.W., Washington, D. C.**

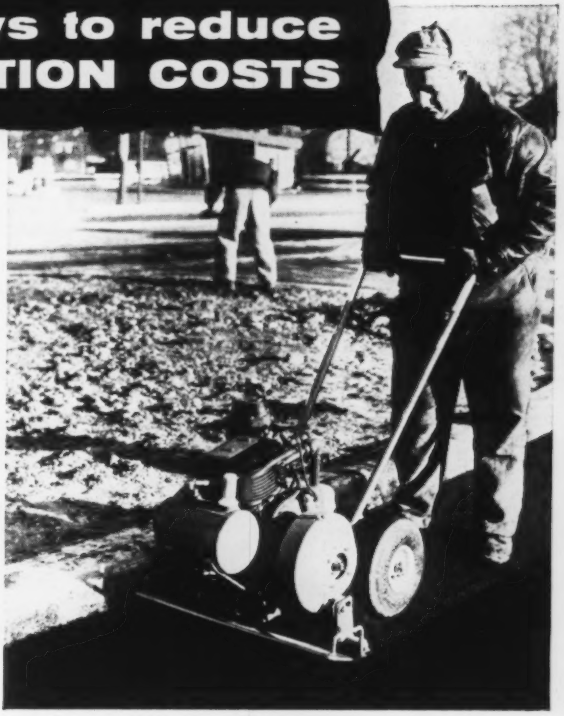
Sealdtank

A GIANT RUBBER-FABRIC container that looks like an overgrown toothpaste tube and may revolutionize the transportation of liquid cargo for the trucking, railroad and barging industries has been developed. Called the Sealdtank, it makes possible for the first time the dry, liquid two-way haul—transporting dry cargo in one direction and liquid cargo in the same standard trailer or truck on its return trip. For the railroad industry it converts every box car and gondola car on the rails today into a potential liquid carrier. The same is true for barges, and for industrial plants the new tank provides an economical and efficient method of large volume liquid storage. The container is 56-in. in dia, 35-ft long and holds 3,800-gal of liquid. It weighs 1040-lb empty and its capacity when filled with molasses, for example, is 22-tons. When empty it lies flat and can be rolled into a compact, cylindrical package 25-in. in dia and 7-ft 4-in. in length. **United States Rubber Co., CE-1, 1230 Ave. of the Americas, New York 20, N. Y.**

Mars Design Contest Being Repeated

TO PROVIDE A "SHOWCASE" for worthwhile projects which often, in spite of merit, do not come before interested technical audiences, Mars Pencils is sponsoring its second (1958) annual design contest. $100 is paid to winners simply for the right to reproduce their designs in the Mars Outstanding Design Series. There are no strings attached; the designer is given full credit and retains all future rights to the project. In 1957, four winners received cash awards and there were 14 honorable mentions. The subject can be almost anything—aviation, space travel, autos, trains, buildings, engineering structures, household items, tools, machines, business equipment, etc. Projects will be selected on the basis of appeal to design-minded readers, broad interest, attractive presentation. **J. S. Staedtler, Inc., CE-1, Hackensack, New Jersey.**

2 sure ways to reduce COMPACTION COSTS



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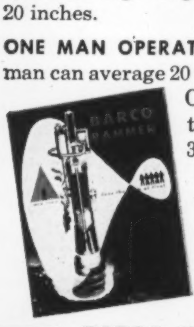
Put Barco Rammers on the job and watch the results. One of the biggest advantages they offer is ability to handle work in minimum time.

HIGH DEGREE COMPACTION—In test after test, Barco Rammers have demonstrated their ability to deliver 95% to 97.5% compaction (modified Proctor Method)—EASILY! EFFICIENTLY! ECONOMICALLY!

FOR TOUGH JOBS—The Barco Rammer is especially useful for compacting fill in restricted areas close to walls, culverts, and abutments—in trenches, ditches. ONLY the Barco Rammer can produce specified high degree compaction on lifts up to 20 inches.

ONE MAN OPERATION—On area tamping, one man can average 20 to 30 cubic yards of fill per hour. On trench backfill, using lifts up to 24″, the rate for 18″ trench is 360 to 600 feet per hour.



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THE BARCO VIBRA-TAMP

The new Barco VIBRA-TAMP is a proven tool—superior in design and performance—backed by leading equipment distributors representing Barco in all parts of the country.

VERSATILE PERFORMANCE—For vibratory compaction of granular base materials and tamping bituminous surfacing.

ECONOMICAL—to buy, operate, and maintain! No special tools required. Saves your bigger, costlier equipment. Tamp up to 750 sq. yds. per hour. A real work-horse on sand, gravel, soil, chippings!

EFFICIENT, DEPENDABLE—One man does the work of many with VIBRA-TAMP. Self-propelled. Operates in any weather. Works flush against curbs, foundations, and walls. Simple design and quality construction keep the machine on the job day in and day out. Moving parts fully enclosed. Handle adjustable to comfortable height.

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at LESS COST!

Ask for Catalog 630

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for High Degree Soil Compaction

BARCO VIBRA-TAMP
for Granular Fill and Bituminous Surfacing

SURVEYORS!

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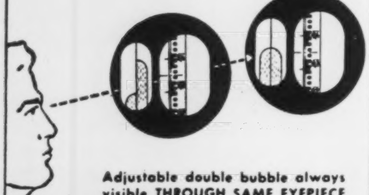
NEW LEVEL with



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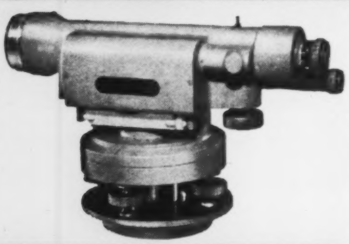

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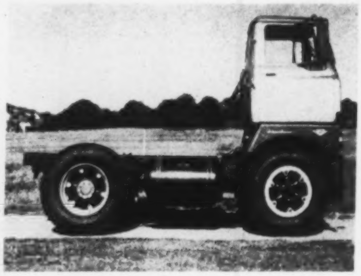
EQUIPMENT MATERIALS and METHODS

(continued)

Bumper-to-Back-of-Cab

A new line of cab-over-engine truck tractors with unique 48-in. bumper-to-back-of-cab dimension to haul maximum payloads has been placed in production. Designated as "Sightliner" models, these trucks are offered in the ACO-190, 200, and 220 series, are available in gross vehicle weight ratings from 24,000 to 30,000-lb, and come in five wheelbases: 98, 104, 116, 128, and 140-in. They are powered by International heavy-duty V-8 gasoline or LPG engines, and will be available with diesel power at an early date. **International Harvester Co., CE-1, 180 N. Michigan Ave., Chicago 1, Ill.**



Floating Pump House

With an unusual floating pump house, which is feeding 14 million gal of process water a day to a new glass plant, intakes are maintained at a constant immersion depth, regardless of the river level. Pumps and intake screens are mounted on a welded steel barge, moored to 4 steel sheet pile cells and fitted with pneumatic-tired wheels at each of its corners. The wheels run in I-beam tracks welded to the sides of the cells, which rise 60-ft above the normal water level. Mounted atop the 2 landward cells is a steel hose reel, grooved to receive 5 rubber hoses attached to an elbow loading into the hollow axle of the reel. To the axle is connected a pipe which leads along a steel grid walkway to the shore and up the river bank to a water treatment plant. Steel cables, wrapped around the flanges of the reel and leading down to the barge on the riverward side and through a fixed sheave between the cells up to the barge on the shore side, control rotation of the hose reel. The hoses are always properly spaced between barge and reel: when the river rises, lifting the pump barge, the cables are pulled down, automatically reeling in the hoses; when the river falls, the hoses are paid out. **Dravo Corp., CE 1, Neville Island, Pittsburgh 25, Pa.**

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EQUIPMENT MATERIALS and METHODS

(continued)

Dependable Power Steering for Motor Graders

THE GYDE-MASTER POWER STEERING Unit is an hydraulic-powered steering booster incorporating control valve and power section in one compact housing. It mounts in the steering shaft of a vehicle and provides control by applying torque to the shaft. The unit provides effortless turning for the operator, holds the vehicle on its course and absorbs road shocks applied to the front wheels. Because it replaces the operator for almost all steering operations, it reduces the time spent watching the vehicle and allows more time for manipulation of implements, speeding work and reducing operator fatigue. **Precision Controls Co., CE-1, 5038 Chowen Ave., South, Minneapolis 10, Minnesota.**

Hydraulic-Powered

"Plug-In Limit" Switch

A NEW TYPE OF precision limit switch that can be replaced on the job in a few seconds with no required adjustments has been introduced. Called the "Plug-In Limit," it answers the need of high-speed, automatic production lines for a longlife precision limit switch which allows immediate replacement. The unit consists of two parts; a terminal block enclosure, containing wiring connections, and a switch enclosure, including all moving mechanical and electrical parts. The switch enclosure is fitted with four current-carrying spring plugs, integrally molded to the basic switching element, and the terminal block with four corresponding receptacles. When plugged together, they form a complete switching unit. Actuating arms may be pre-set to **Switch Div., Minneapolis-Honeywell Regulator Co., CE-1, Freeport, Ill.** eliminate on-the-job adjustment. Micro

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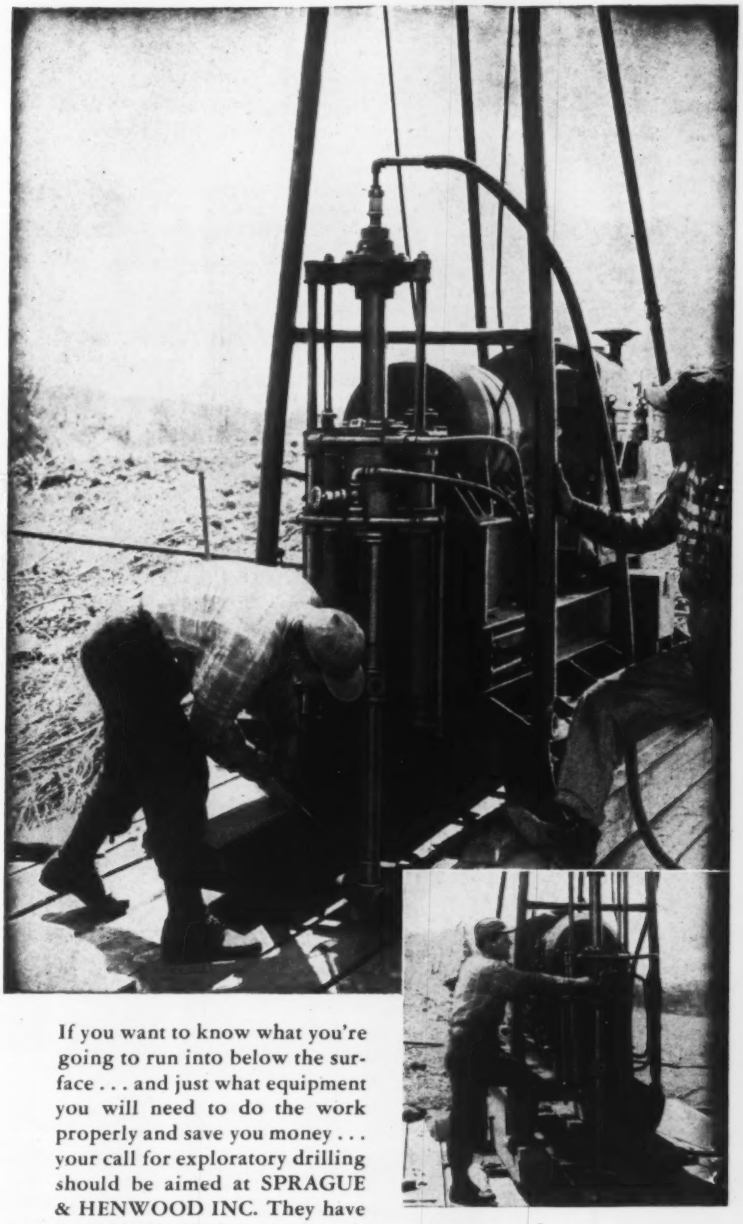

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EQUIPMENT, MATERIALS and METHODS

(continued)

Reflective Letters

NEW REFLECTIVE LETTERS 500 times brighter than white paint—for traffic signs requiring extra brilliance, even in semi-lighted areas—have been announced. They are made of a "Scotchlite" brand reflective sheeting which is covered with a rigid, transparent plastic sheet and backed with a flexible plastic film, and include numerals, arrows, borders, periods, hyphens, and diagonals for fractions. **Dept. R7-321, Minnesota Mining and Manufacturing Co., CE-1, 900 Bush St., St. Paul 6, Minnesota.**

Largest Lightweight Concrete Pipe Cuts Costs

A FAMILIAR SIGHT TO THE thousands of bathers at California's popular Huntington Beach State Park is the Southern California Edison Company's new multimillion dollar steam generating plant. Situated just off U. S. Highway 101, its two pipelines reach over 1800-ft into the blue Pacific to circulate a maximum of 352,000 gallons per min of sea water completely through the plant's large condensation system. Made up of 16-ft long sections, each section has a 14-ft inside diameter. There are 230 of these used in the job, and each one weighs 50-tons. Ordinarily, concrete pipe sections of this size would weigh about 75-tons, but because of the use of lightweight concrete aggregate, the weight was reduced by ⅓ and approximately ⅓ of the cost of laying the pipe was cut. **Rocklite Products, CE 1, Ventura, California.**

Model D Spray Leader Bituminous Distributor

THE SPRAY LEADER DISTRIBUTOR, a heavy-duty bituminous distributor, equipped with the durable controls required for applying every type of bituminous material, is now available. It contains such advantages as a hi-low flue system which heats a smaller amount of material, at the lowest possible level, a heavy-duty Viking pump which will handle the longest spray bar with ease, the "Lite-Wate" circulating spray bar which is engineered to apply all types of asphalt, tar emulsion, road oils, and cut backs, and weighs only half as much as heavy steel bars, but is built to take punishment under rugged duty. **Littleford Bros., Inc., CE 1, 453 Pearl St., Cincinnati 2, Ohio.**

1000-lb Capacity Scale

A NEW PORTABLE BEAM scale for general use in industry and agriculture has been produced. Known as the Model "57", this new scale has a capacity of 1000-lb. Construction is all metal, with a solid cast iron platform, and steel wheels. The understructure incorporates Howe's simplified lever system, with ball bearing platform support designed to absorb loading shocks and reduce wear on the scale points for continued accuracy. The platform overlaps the base to keep out dirt and dust, but is easily lifted for periodic lubrication. Four types of beam are available—single, single with drop lever, double, and full capacity "Du-al." **Howe Scale Co., CE-1, Rutland, Vermont.**

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Model 38-bF

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Practically eliminated during an entire lifetime of service are repairs and maintenance to a Warren-Knight Transit-Level. The design and construction of these superb instruments is so superior and so different that it is prudent to investigate them, if you are in the market. After all, an instrument that promises probable total elimination of repairs and maintenance — and will probably never be replaced during your entire remaining professional career — certainly offers you a dramatic saving.

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Wobbler Feeders

Two UNIVERSAL WOBBLER FEEDERS, now classifying 1200-cu yd of gravel per hr on the Casitas Dam project, Oak View, Calif., will enable the contractor to operate continuously to the completion date of the fill contract, Feb. 2, 1959. The project is under contract to Winston Bros. Construction Co. and will require 3,948,000-cu yd of fill material. Of this, 3,207,000-cu yd are to be minus 3-in. and 741,000-cu yd are to be plus 3-in. Source of material is a sandstone and gravel pit near the construction site containing 83% under 3-in. and 17% over 3-in. Moisture-filled sandstone and gravel is chuted to the feeder from dump trucks 21-ft above. Each Wobbler bed is composed of 16 oval-shaped, ribbed bars positioned alternately vertical and horizontal. They are set at angles of 90-deg to each other and timed to maintain the same relative positions as they turn. Material dumped on the beds is given a rocking, tumbling motion as the bars revolve. Minus 3-in. material is worked loose from the larger pieces and dropped through spaces between the bars. Oversize is delivered off the end. Some 14-in. of winter rains cause material to plug hoppers but Winston Bros. are said to have saved more than $30,000 on classifying by this method. **Universal Engineering Corp., CE-1, 625 "C" Avenue, N.W., Cedar Rapids, Iowa.**

Candid Decade Scaler

AN IMPROVED BASIC DECADE scaler for precision counting and registering of electrical impulses has been introduced. Known as the Candid Decade, Model DS-1A, it is designed specifically as a high quality scaler for the nuclear field. Equipped to power all basic nuclear detectors—proportional, scintillation, Geiger-Mueller and neutron instruments, it contains a continuously variable high voltage power supply for operating the detectors. Outstanding feature of the scaler is its built-in safety factor to prevent counting errors. In approximately 95% of all circuit malfunctions, the instrument will signal by an ambiguous count. **Nuclear Measurements Corp., CE-1, 2460 N. Arlington Ave., Indianapolis 18, Ind.**

Rapid Reset Register

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SEALTIGHT Hydromat ASPHALT LINERS

Pre-fabricated "HYDROMAT" Asphalt Liners provide the ideal liner for all domestic, industrial and recreational facilities where the containment of water, wastes, sludges, brines, etc. demand a very efficient, economical and impervious lining material. "HYDROMAT" is quickly and easily installed as a monolithic liner with mechanically sealed joints . . will expand and contract with soil movements without rupturing or breaking the seal. Installed over (exposed) or under earth, concrete, gunite, steel or other materials... provides the practical answer to the problem of re-lining old, cracked concrete or gunite linings. "HYDROMAT" may be safely used for the containment of potable water in clear well construction and its ruggedness and durability permit its use as a fully exposed lining in large reservoirs to depths exceeding 50 feet. "HYDROMAT" is available in three thicknesses, ½″, ¼″ and 5/32″, in 4′ widths and lengths up to 15′ . . . longer lengths available on special request.

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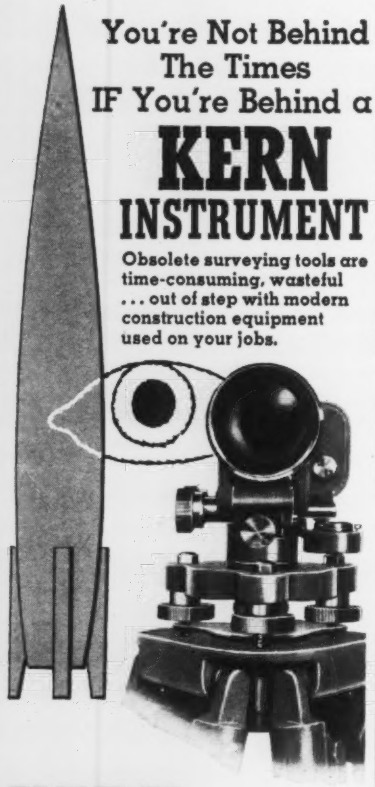

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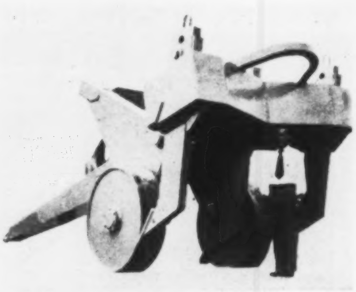
EQUIPMENT MATERIALS and METHODS

(continued)

Wheel-Type Drawn Ripper

A NEW, 25,000-LB, wheel-type, drawn ripper has been announced. Known as the Southwest Extra Heavy RXH-3, it boasts structural features such as box beam sections of special design to withstand the most severe job conditions. Through a predetermined and set angle of the ripper shanks, quick, positive penetration is assured. Shanks are of special alloy heat treated steel forging of correct ductility so as to resist shocks and strains imposed on them. Points are replaceable to them, and are hard-faced to give maximum resistance to wear. The wheels are drum-type, mounted on Timken bearings. All rotating parts are designed for easy lubrication. Ripping depth is controlled through the cable and is quick and positive. **Southwest Welding and Mfg. Co., CE-1, 3201 W. Mission Rd., Alhambra, Calif.**



Extra Heavy RXH-3

New Concept in Grating Design

A ROLL-LOCK ALUMINUM grating is now being pioneered for installations in chemical plants, oil fields, and confined areas where corrosion resistance and spark-proof features are either imperative or highly desirable. It provides crimped bars permanently roll-locked into bearing bars to form a solid, one-piece, rattle-proof unit. Strong, yet lightweight, and designed to blend with the new look in buildings, it is available in Alcoa's sunfast architectural colors. These plus the modern design make it handsome and decorative for grills, wall panels, sunshades, and column facings. There is also a designed-in flexibility feature: one side of the grating is grooved for maximum anti-slip protection; the other side is smooth-surfaced and can be reversed to form a slide-path for the movement of bags, boxes, and other products. **Kerrigan Iron Works, Inc., CE-1, Nashville, Tennessee.**

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Drilling

CORE BORINGS
for
Foundations, Dams,
Bridges and all
Heavy Structures
GROUT HOLES

Tinney Drilling Co.
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PHOENIX BRIDGE COMPANY

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BRIDGES and BUILDINGS

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and Shops

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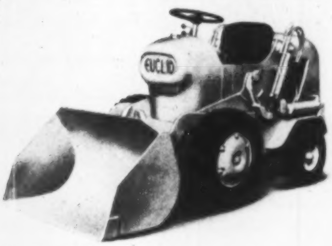
Subsidiary—Barium Steel Corporation

Front End Loader

A NEW FRONT END loader with a rated payload capacity of 19-cu ft has been announced. Struck capacity of the bucket is 14-cu ft—maximum lifting load is 3,000-lb. Designated as the Model L-7, the rubber-tired loader is now being introduced after two years of development and extensive field test in foundries, steel mills, chemical and fertilizer plants as well as other industrial operations. It is the first, and smallest in capacity, of several loader models that will be built by Euclid for bulk material handling and other work suitable for front end loader equipment. It has a number of features that provide exceptional maneuverability, easy operation and good versatility for intra-plant material handling. Conveniently located controls provide instant response. Compact design permits operation in confined areas where other power equipment cannot be used. Equipped with torque converter and power shift transmission having synchronized non-stop high-low shift, speeds range up to 11-mph forward or reverse. There is an interconnecting valve between foot brake and the driving clutches within the transmission which permits machine to ease into restricted areas merely by operation of foot brake. **Euclid Division, General Motors Corp., CE-1, Cleveland 17, Ohio.**



4-ft Wheel Base

Speedy Moisture Tester

MOISTURE CONTENT OF SANDS, clays and other materials used in foundry and other practices can be determined in 40-sec by the Speedy Moisture Tester. This permits actual control in mixing or mulling operations as mixes may be tested before they are unloaded and correction made if moisture content is off. The tester is a compact portable unit, as foolproof as it is possible to build an instrument. It requires no figuring as moisture percent is read directly on the dial. **The Alpha-Lux Co., Inc., CE-1, 155 John St., New York 38, N. Y.**

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EQUIPMENT MATERIALS and METHODS

(continued)

Cathode-Ray Recorder

The first production model of the new 204-A12 Dynamic Temperature and Strain Recorder has just been completed. It features 12 channels of simultaneous data in addition to a calibrated linear time base and zero time on a 10-in. wide by 31½-in. long record. The model is designated especially for the high-speed recording of short-term dynamic phenomena such as encountered in ballistic and related investigations. The canted position of the drum camera and c-r tubes is only part of the unique packaging which gives 8 more channels of information than previous models, with less than 10% increase in effective volume. The recorder includes amplifiers, timing circuits, automatic sequencing and control circuits, and a drum camera with driving mechanism for 3600-rpm operation. **Allegany Instrument Co., CE-1, 1091 Wills Mountain, Cumberland, Maryland.**

Photocopier

A patented plastic air-cushion makes the brief-case Contoura-Portable the only photo copy machine useable *face-down* on open books, magazines, all bound material, following page contours right to the margins to make photo-exact copies in 30-sec. Producing crisp, black-on-white, permanent copies, at *no damage to originals* it cuts time, labor, and material costs, reproducing a page for 11 cents, compared to 60 cents to type and proof-read the same material. Light and compact, the machine is precision engineered to perform in library, courthouse, or on trips. **F. G. Ludwig Inc., CE-1, 105 Coulter St., Old Saybrook, Connecticut.**

Slope-Beam System for Flat Roof Design

A new concept in low-profile building design—slope beam roof system—offering a substantial savings in labor and material costs has been introduced. It is a custom designed, fully integrated, complete framing unit package, which includes natural slope steel beams, and steel purlins to be used with most types of roof deck. The principal structural element around which this system is designed is the Steelcraft Slope Beam, a welded assembly of structural steel plates fabricated in an automatic continuous welder. **Nat. Lehman, The Steelcraft Mfg. Co., CE-1, 9017 Blue Ash Road, Cincinnati 42, Ohio.**

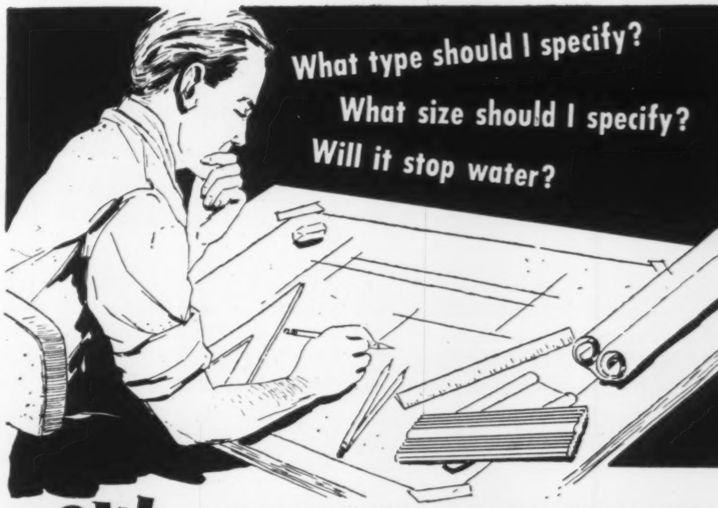
Diamond Drill

THE RECENTLY DEVELOPED DIAMOND Drill is announced as weighing 37-lb, having depth capacities up to 200-ft, and rated capacities for core diameters up to 6-in. Among the unit's application are marine drilling, rock and concrete coring, blast hole drilling and soils sounding. Economic advantages include fuel consumption neighboring 2-gal per shift and as little as 1½-gal of water consumed per foot of drilling. An overhead drive principle allows up to 10-ft strokes without rechucking the drill rod. Maximum core recovery and diamond bit economy are results of the machine's exacting dynamic balance. Penetration speeds in excess of 1-ft per min have been obtained at depths of 100-ft according to the manufacturer. Engineering features include a water cooled gear box, safety clutch, built in water swivel, and a convenient bullseye level. An aluminum magnesium alloy construction is used in the drill and engine, which is assembled by units for service convenience. A 5¼-hp, 2 cycle gasoline engine with a vacuum carburation system allows continued all angle drilling. A mechanical advantage lever may be used for applying pressure in hard rock drilling and deeper holes. **Wink Corp., CE-1, 1518 N. 117th St., Milwaukee 13, Wisconsin.**

Weighs 37-lb

New Innovation in Uni-Form Panel System

THE NEED FOR SPECIAL concrete chutes or job fabricated chutes is eliminated with the use of a standard Uni-Form Panel and adjustable pilaster form. Universal Form Clamp Co. engineers have devised a simple method of providing a combination pouring pocket and concrete chute by using standard items. The panel quickly becomes a chute when tilted into position and secured with bolts to adjustable pilaster forms. After pour is made, bolts are removed and form is pushed back into place. **Universal Form Clamp Co., CE-1, 1238 N. Kostner Ave., Chicago 51, Ill.**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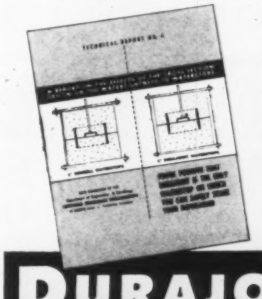

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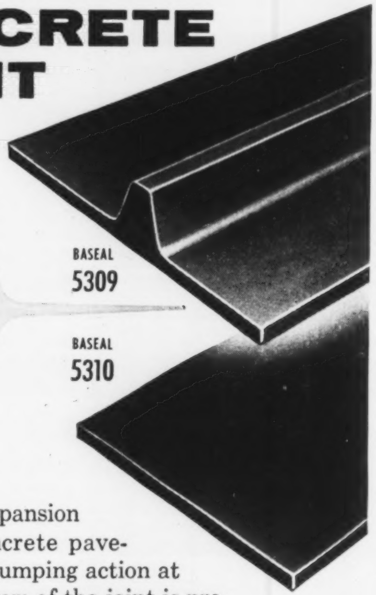

For maximum protection of expansion and contraction joints in concrete pavement, and the elimination of pumping action at joint intervals, be sure the *bottom* of the joint is protected against water seepage and the infiltration of foreign materials. Specify Servicised "BASEAL"—a resilient rubber base plate for expansion and contraction joints—made in two types, specifically designed for optimum performance and joint protection. "BASEAL" provides long-time protection because it is an extremely stable rubber compound, resistant to deterioration caused by fungus growth, etc.

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Drawings at right show Servicised "BASEAL" in place in expansion and contraction joints.

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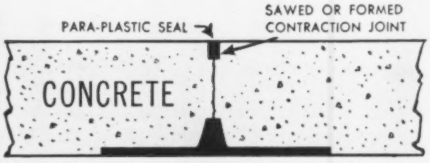
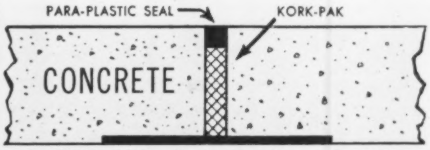


"BASEAL" 5309 sealing bottom of contraction joint



"BASEAL" 5310 sealing bottom of expansion joint

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EQUIPMENT MATERIALS and METHODS

(continued)

Urethane Foam Laboratory

DuPont's new 6,000-sq ft laboratory has been built to evaluate equipment and techniques used in the manufacture of urethane foam products. It is provided with a spray booth large enough to spray full-size building panels, automated prototype equipment for molding cushions, a molding line for larger items, and slitters and die cutting machinery. One of the largest pieces of equipment in the new laboratory, the cushion molding line, duplicates production line techniques by using a conveyor belt system for handling production flow. The line consists of a preheat oven, station for filling the molds, and a curing oven. An overhead traversing mechanism assures an even fill for each mold. Another molding line, which will handle practically any mold up to a full-size mattress, has been designed to help customers work out mass production techniques. The slitters can be set to slice slabs of urethane foam as thin as an eighth of an inch, and the die cutting equipment can cut the material into any shape or pattern desired. **E. I. DuPont de Nemours and Co., CE-1, Wilmington, Delaware.**

Multi-Range, Multi-Purpose Torque Wrench

A completely new approach to high torque application requirements has been announced. Now by using a conventional light weight, small size and low capacity torque wrench, the range is increased as high as 900-ft lb. A number of versatile combinations are available as standard stock items. A normal 150-ft lb capacity wrench can be increased for applications as high as 300-ft lb, a normal 200-ft lb as high as 400-ft lb, and a 300-ft lb to 600 or 900-ft lb. The torque wrench adapter accessory is a heavy duty, light weight, conventional hand tool that enables using box end openings, rachet end or a conventional drive square so that sockets can be used. Each of these may be interchanged and yet maintain the proper lever length of the adapter. A wide range of box end openings are available from ¾-in. to 2½-in. Some customers will find it necessary only to invest in a single torque wrench rather than two or even three, due to the multi-range feature of this new product. It will in many instances result in a substantial saving for users in the service field. **P. A. Sturtevant Co., CE-1, Addison, Illinois.**

Literature Available

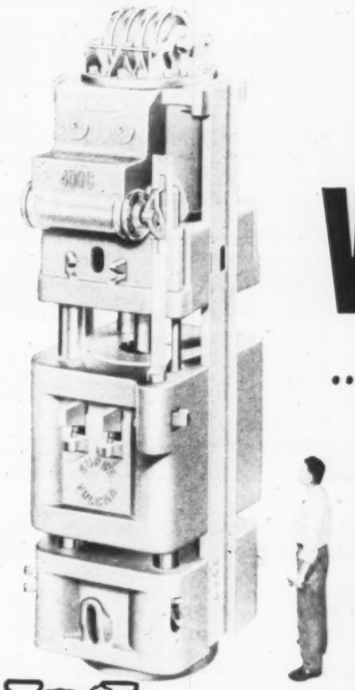
Steel Concrete Casting Forms—A new 20-page bulletin #300, describing the full line of Form-Crete casting forms is now available. It is indexed by form types for easier reference. The sections include Double T, bridge beams, I beams, piling and other standard types plus a section showing a number of custom forms that were designed to customer specifications. Important additions to the Form-Crete line are forms for the P.C.I.A.A.S.H.O. approved bridge beams, various Double T forms and many casting accessories. Each form is illustrated and specifications are described in text and charts. **Food Machinery and Chemical Corp., Florida Div., CE 1, P. O. Box 1718, Lakeland, Florida.**

Transistorized Power Supply—Bulletin ECR-490A concerning the new Transistorized Power Supply for two-way radio units, has been published. It provides advantages of transistor power without obsoleting the user's existing radio equipment, and makes possible system modernization without expensive maintenance. The cost of installing the new device is written off in savings from lowered maintenance expenses resulting from fewer vibrator replacements and service calls. **General Electric Communication Products Department, CE-1, Syracuse, New York.**

Cold Weather Concreting—The folder, "Craftsmanship in Concrete" is now available. Dealing with cold weather concreting, it offers hints for successful placing, finishing and curing, and also provides many sound precautionary measures for winter concreting. **Alpha Portland Cement Company, CE 1, 15 S. Third Street, Easton, Pennsylvania.**

Cutting Operating Costs—Industrial Survey DH-538 made by field engineers shows how contractors, builders and related operators in a wide variety of construction activities are getting more profits from their facilities by cutting unnecessary labor and maintenance costs, and by reducing downtime. More than 50 illustrated case histories outline specific results obtained by construction companies, and should prove of considerable assistance to others with similar problems. **Dept. 117-C, The Gates Rubber Co., CE 1, 999 So. Broadway, Denver 17, Colorado.**

Hi-Test Pipe—A complete line of cast iron soil pipe, fittings and related items for water, oil and gas service lines are discussed and fully-illustrated in a new booklet. All dimensions and weights are extensively outlined in this 4-page 2-color folder. Complete specifications, including pipe lengths and bursting pressures are also given. **Attalla Pipe & Foundry Co., Inc., CE 1, P. O. Box 211, Attalla, Ala.**



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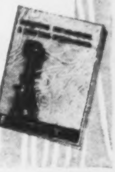

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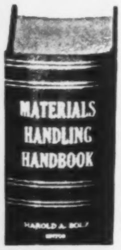

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Literature Available

Concrete Carriers—A new, profusely illustrated brochure describing 4-wheel and 6-wheel drive concrete carriers has been prepared. Action photographs from widely divergent points in the northern and southern hemispheres show how the all-wheel traction spots concrete where it is wanted despite adverse operating conditions of weather, off-highway hauling, congested traffic. A combination photograph and diagram illustrates the smaller turning circle and greater maneuverability inherent in this equipment. **Oshkosh Motor Truck, Inc., CE-1, Dept. CC, Oshkosh, Wisconsin.**

Expansion Joints—A new manual concerning expansion joints and their uses has been made available. Entitled "Design Practices and Uses of Premoulded Joints in Concrete Pavements," it includes comprehensive technical data and illustrations on the many types of premoulded joints, their applications and installation information. **Expansion Joint Institute, CE-1, 121 Hill Ave., Aurora, Illinois.**

Duo-Pactor—How to slash equipment costs by using only one machine to do all types of fill and base compaction, seal coating, and surface rolling is explained and illustrated in "Compact Facts about the New and Revolutionary System of Duo-Paction." This new booklet shows how the combination of pneumatic and steel rolls in a self-propelled unit enables the Duo-Pactor to do the work of two or more separate types of equipment, and how the alternate action of rubber and steel rolls produces higher densities with big power savings. **Seaman-Gunnison Corp., CE-1, 2763 S. 27th St., Milwaukee 15, Wisconsin.**

Engineering Services—Available is a new 88-page general catalog of The Rust Engineering Co. and subsidiary companies which is designed to show the scope of its engineering and construction services. There are over 200 picture examples of work performed. Separate sections are devoted to work for individual industries, such as atomic, cement, glass, power, chemical, metallurgical and pulp and paper. Another section contains a map showing job sites and a representative list of more than 400 clients with indications of the number of contracts undertaken for each. **The Rust Engineering Co., CE-1, 930 Fort Duquesne Blvd., Pittsburgh 22, Penna.**

Conveyor Track—A new bulletin, Form No. FT-57, illustrates the many applications of the Rapistan Flow Track and shows how it can be combined with other conveyors or be used in various combinations of itself for a multitude of purposes. The new literature also includes complete specifications. **Rapids-Standard Co., Inc., CE 1, 342 Rapistan Building, Grand Rapids, Mich.**

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Films Available

"Lift Slab"—The Lift Slab method of constructing and erecting concrete floors and roofs down on the ground instead of up in the air is shown and described in a 30-min film. "On the job" pictures show pouring the footings, erecting the columns, pouring the slabs one on top of the other, and lifting and securing slabs in place. Engineering limitations and freedoms of the Lift Slab method are described. **Edward D. Gray, Great Lakes Lift Slab Corp., CE-1, 5306 W. Lawrence, Chicago, Illinois.**

"Three Dimensional Drafting"—Engineers, draftsmen and production executives will be interested to learn that a new educational sound film on "3 Dimensional Drafting" is now available. It compares this new modern technique with conventional methods, and shows the many advantages of the 3-D methods over the flat plain or orthographic drawings. **John R. Cassell Co., CE-1, 110 West 42nd St., New York 36, N. Y.**

"Here's How, With Clay Pipe"—The latest and most efficient methods of sewer construction are presented in a new sound, color film. The 20-min movie describes, in actual location sequences, how to construct modern underground waste systems. Among the basic steps fully explained and demonstrated are excavating, sheeting and bracing, bedding, laying, jointing and backfilling. **Mr. Robert Scott, Clay Products Association, CE-1, 100 North LaSalle St., Chicago 2, Illinois.**

"Jonah and the Highway"—Dedicated to the highway engineer as a public service, this 27-min film is unique in many ways and is designed to focus attention on one of the most ambitious modern engineering undertakings—the building of the nation's projected highway network. Produced in Hollywood for wide-screen theatrical projection, it is a part of U.S. Steel's "Keep-Our-Roads-On-The-Go" Program, and will be seen in many movie houses and drive-in theatres throughout the country. **United States Steel Corp., CE-1, 71 Broadway, New York 6, N. Y.**

Color Films—Available on a free loan basis, these 14 sound-color films describe various aspects of mining, steelmaking and the manufacture of finished steel products. Four belong to the unusual "Indian Paint" series, and depict the first discovery of iron ore by the American Indian who used the powdered ore for face paint. The scene then shifts to modern steelmaking operations, with dramatic photos of the blast furnaces and open hearths. **The Colorado Fuel and Iron Corp., CE-1, P. O. Box 1920, Denver 2, Colorado.**

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MANUFACTURE RESUMED: Alundum non-slip stair and floor tiles, discontinued in 1955, are once again being manufactured. The Norton Company stopped making tiles at that time to concentrate its efforts in the non-slip flooring field on the making of abrasive aggregates, used in terrazzo and cement floors and stairs . . . **BUY-BACK PLAN:** A plan intended to increase the availability of bank credit for contractors and other customers has been announced. Under the plan, Koehring Co. will underwrite credit arrangements negotiated between the equipment buyer and his bank. A descending scale of values has been set up at which Koehring will repurchase the equipment if the buyer defaults in his payments to the bank . . . **NEW ACQUISITION:** Sun Chemical Corp. has signed a contract to buy Ansbacher-Siegle Corp., leading independent pigment manufacturer . . . **MERGERS:** The Heltzel Steel Form and Iron Co., Warren, Ohio, for almost half a century one of the leading manufacturers of steel forms for concrete shaping, has joined with Leap, Inc., Lakeland, Florida, to design and produce a complete line of forms and accessories for the manufacture of prestressed concrete products . . . Edward J. Quirin, president of Frederic R. Harris, Inc., consulting engineers, announced the merger of his company and the international management consulting firm of Wallace Clark and Co., Inc. . . . **RETIRED:** Clessie L. Cummins has retired as Honorary Chairman of the Board and as a director of Cummins Engine Co., Inc., Columbus, Indiana . . . **TRUCK SALE:** Mack Trucks, Inc., has disclosed the sale of four huge 30-ton dumpers to the Alcoa Exploration Co., a wholly owned subsidiary of Aluminum Company of America, for use in Alcoa's Bauxite mining operations in the Dominican Republic . . . **EXPANSION JOINT INSTITUTE:** A recent development of interest to the construction industry is the formation of the Expansion Joint Institute. Membership is composed of representatives of the following organizations: The Celotex Corp., W. R. Meadows, Inc., Presstite-Keystone Engineering Products Co., and Servicised Products Corp. . . . **NEW PRODUCT:** Electricweld pipe in four standard sizes between $6\frac{5}{8}$-in. and $12\frac{3}{4}$-in. OD is a new product of Jones and Laughlin Steel Corp., Pittsburgh. These products, now being made on the company's previously announced $8,000,000 mill, offer new possibilities for use in various industries where the more expensive, heavier wall seamless tubing has been required . . . **APPOINTMENTS:** Robert R. Eastty has been appointed Sales Manager of Kerrigan Iron Works' Bridge Flooring Division. His headquarters will be at Kerrigan's General Sales Offices, 274 Madison Ave., New York City.

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November

1442. Discussion of Proceedings Papers 1106, 1189, 1233, 1234, 1254, 1255, 1303, 1316, 1318. (ST) Robert M. Barnoff closure to 1106. Anthony M. DiGioia on 1189. John E. Goldberg, Kenneth H. Lenzen, R. A. Williamson, Zdenek Sobotka, E. Neil W. Lane on 1233. DeForest A. Matteson, Jr. on 1254. Masso Naruoka, Benjamin C. F. Wei on 1255. Masso Naruoka on 1303. T. Au on 1316. Masso Naruoka on 1318.

1443. Electric Analog for Level-Net Adjustment, by Hsuan-Loh Su. (SU) A method is suggested, using the analogy between the electrical network and the level net, for adjustment of a level net. Calculation methods are simple, and results are automatically checked.

1444. Electronic Computers in Surveying Operations, by Arthur J. McNair. (SU) Examples of computing both routine and more elaborate problems by use of electronic digital computers in surveying operations are given. Opportunities for new concepts in the teaching of surveying by use of an electronic computer are described.

1445. Distance Measurement with the Geodimeter and Tellurometer, by John S. McCall. (SU) The practical uses of the measurement of distances by electronic means are presented in this paper. Some of the applications would include rapid measurement of lines of a triangulation net, traverse in rough country or over bodies of water, and coastal hydrograph surveys.

1446. Surveying and Mapping, St. Lawrence Power Project, by John D. Officer. (SU) The agencies developing the St. Lawrence Power Project solved many surveying and mapping problems while obtaining detailed topographic and property maps, and establishing horizontal and vertical control for structures. Each agency had a different method of accomplishing the same coordinated results.

1447. A Meteorological Method for Profile Surveying, by L. V. Toralballa. (SU) This paper derives a hydrodynamic equation similar to that which underlies the method generally known as Airborne Profile Recording, but one that is free from the assumption that the wind is geostrophic. An aircraft is made to fly along an isobar and certain atmospheric measurements are taken enroute, as well as at the ends of the trajectory and on the two ground points.

1448. Discussion of Proceedings Paper 1064. (SU) E. D. Morse closure to 1064.

December

1449. The Hydraulic Jump at an Abrupt Drop, by Walter L. Moore and Carl W. Morgan. (HY) The role of the drop in determining the form of the drop and in stabilizing its position is clarified by analysis and experiment. Application of results is illustrated by examples.

1450. Transition from Laminar to Turbulent Flow in a Pipe, by M. R. Carstens. (HY) Transition from laminar to turbulent flow was observed during flow establishment in a smooth, straight pipe. Turbulent spot formation was in qualitative agreement with the Tollmein-Schlichting theory of small disturbances.

1451. Flood Frequencies Derived from Rainfall Data, by Joseph L. H. Paulhus and John F. Miller. (HY) A long record of peak discharges may be synthesized for any basin having a streamflow record of sufficient length to derive a unit hydrograph and to test a rainfall-runoff relation.

1452. Flow Characteristics on the Ogee Spillway, by Robert B. Jansen. (HY) A simple formula is developed for determining energy loss on an overflow spillway face. A criterion for establishing the pattern of velocity variation along a level spillway apron is considered.

1453. Discharge Characteristics of Rectangular Thin-Plate Weirs, by Carl E. Kindsvater and Rolland W. Carter. (HY) A solution for discharge characteristics of rectangular, thin-plate weirs is based on a simple equation of discharge, and experimentally derived coefficients. The solution is compared with other experiments and formulas.

1454. Air Binding in Large Pipelines Flowing Under Vacuum, by R. T. Richards. (HY) This paper examines the phenomenon of air binding and methods of control, with emphasis on the accumulation of air in sloping pipes.

1455. Flow Through Circular Weirs, by J. C. Stevens. (HY) This paper presents a formula for theoretical flow through sharp crested circular weirs, involving use of elliptic functions.

1456. Discussion of Proceedings Papers 1015, 1082, 1165, 1201, 1260, 1264. (HY) J. C. Stevens closure to 1015. Aly Fathy and Aly Salem Shukry closure to 1082. H. Alden Foster closure to 1165. Robert T. Knapp on 1201. Alvin J. Peterka, Alfred C. Ingersoll, S. Leliavsky on 1260. Alvin J. Peterka on 1264.

1457. Design of Large Pressure Conduits in Rock, by F. W. Patterson, R. L. Clinch, and I. W. McCaig. (PO) This paper presents a review of theoretical principles and design assumptions which influence design and describes design, fabrication, and construction of pressure conduits for three developments in Canada.

1458. Factors in Selection of Pieve Di Cadore and Fedaia Dams, by Carlo Semenza. (PO) The procedure followed by a large operating company in Italy in selecting the type of dam best suited to a given locality is described.

1459. Water Resources and Water Developments in Alabama, by Melvin R. Williams. (PO) The water resources of Alabama are evaluated and increasing demands on the supply made by growth and development of the state are described.

1460. Discussion of Proceedings Papers 1184, 1267, 1344, 1350. (PO) Maurice R. Scharff on 1184. William T. Moody on 1267. Carlos S. Ospina on 1344. Carlos S. Ospina on 1350.

1461. Vortex Flow Through Horizontal Orifices, by J. C. Stevens and Richard C. Kolf. (SA) Practical use has been made of vortex flow in combined sewers. For a vigorous vortex, the coefficient of discharge may be as low as 10%.

1462. Fiscal Operations of the Buffalo Sewer Authority, by Frederick W. Crane. (SA) This paper describes the fiscal phases of operation of a metropolitan sewerage system under a public authority organization.

1463. Effect of Local Weather on Air-Pollution Problems, by A. L. Danis. (SA) Valid findings in the study of an air-pollution problem can be made only from local meteorological data. Five cases showing effects of local weather on diffusion of air-borne pollutants are examined.

1464. Sodium Metaphosphate Glass in Water Treatment, by David H. Howells. (SA) This paper provides, by a review of literature and field practices, information regarding sodium metaphosphate glass requisite to its effective utilization by the sanitary engineer.

1465. Lake Intakes, by Carl W. Reh. (SA) The problem of locating water intakes in the Great Lakes poses problems from both a hydraulic and a sanitary viewpoint. Design considerations for lake intakes, and operating histories of several lake intakes are given.

1466. Discussion of Proceedings Papers 1274, 1335, 1337. (SA) R. N. Roberts on 1274. Ralph Stone on 1335. Ralph Stone on 1337.

1467. Opening Remarks, by Mason G. Lockwood. (AT) This paper is a presentation of

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the purposes behind the Jet Age Airport Conference, summarizing its current problems and intents.

1468. Orientation, by Joseph D. Blatt. (AT) This paper examines the responsibility of the civil engineer in planning air terminals to meet requirements imposed by the introduction of turbine powered aircraft into the civil air fleets.

1469. Civil Jet Transport Noise, by Donald A. Buck. (AT) Three years of testing with the Boeing 707 Prototype has provided data on jet engine sound suppressor development and noise considerations. Test results indicate that jet transports can be integrated into world-wide airline systems.

1470. Operational Characteristics of the Douglas DC-8, by J. B. Edwards. (AT) This paper considers planning of aircraft for the jet age, gives a description of the Douglas DC-8, and describes operational capabilities of this aircraft on and around air terminals.

1471. Convair 880 Airport Operations, by A. D. Riedler. (AT) This paper describes the forthcoming Convair 880 jet transport due for airline operation in 1960. Operation at the air terminal and a statement on ground service is presented. Illustrations detail dimensions, range, and power plants, among others.

1472. Jet Age Planning, by James T. Pyle. (AT) This paper examines problems brought up by the impending use of jet transports. Such matters as traffic control, servicing facilities, and certification of jets are treated.

1473. Traffic Estimates and Airport Economics, by Kenneth A. Osterberg. (AT) Airport expenses are a major item of air transportation costs. Terminals should be planned to use space frugally and to avoid overbuilding. Traffic forecasts will assist designers by showing the space required.

1474. Protection of Airport Approaches, by Chester G. Bowers. (AT) Studies on the operating of turbo-prop and turbojet commercial aircraft show that these aircraft do not create new problems regarding obstructions to air navigation. No changes are contemplated by the Civil Aeronautics Administration for determining obstructions to air navigation because of the use of jet aircraft in civil aviation.

1475. Jet Transport Ground Handling, by Donald B. Talmage. (AT) Variations in ground service requirements for the new jet and turbo-prop aircraft are examined. Features of some of the more radical proposals are summarized.

1476. Airports, Planes and People, by William L. Pereira. (AT) The purpose of the jet age airport and passenger is yet to be fully recognized. The master planner and the air industry must design a dynamic, integrated ground complex whose purpose is accommodating the planes and passengers of tomorrow's air travel.

1477. A Statistical Approach to Runway Length, by Ralph T. Glasson. (AT) This paper examines the statistical nature of variables affecting takeoff runway length. Effect of variation on payload, climatological factors, and airplane performance is covered. The need for individual analysis of each airport is stressed.

1478. Airport Configuration, by W. E. Cullinan, Jr. (AT) This paper considers adjustments which are possible in layouts of existing airports to improve efficiency and release areas for building development or expansion. The relationship between runway pattern and airport capacity is also examined.

1479. Effects of Jet Blast and Fuel Spillage on Bituminous Pavements, by W. J. Turnbull and Charles R. Foster. (AT) Studies conducted by the Corps of Engineers for the U. S. Air Force show the critical effects of jet blast and fuel spillage on tar concrete, asphaltic concrete, and rubberized-tar concrete pavements.

1480. USAF Airfield Pavement Problems in the Jet Age, by George W. Leslie. (AT) A review of the experience of the U. S. Air Force with airfield pavements for military jet aircraft is presented for the benefit of commercial operators who will be concerned with providing paved facilities for commercial jet aircraft.

1481. The Jet Age Airport and its Neighbors, by Charles E. Rosendahl. (AT) Airport community problems incident to civil jet aircraft operations are presented in this paper. Noise and vibration problems in the vicinity of air terminals will change as jet aircraft are introduced.

1482. Fueling U. S. Air Force Aircraft, by George B. Seeley. (AT) Fueling systems required by modern jet aircraft are markedly different from those required by the aircraft of World War II. Development of the multiple-outlet system and the filter-meter hose carts is outlined with emphasis placed on the necessity for providing fool-proof operation.

1483. Airport Master Planning for the Jet Age, by Herbert H. Howell. (AT) Continuous increases in air traffic are forecast resulting in greater loads on our airports system. Communities must plan for the future on a system concept because of the interdependence of all airports in the system.

1484. Approach and Runway Lighting for Jet Age Aircraft, by Howard J. Fry. (AT) This paper covers testing of airfield approach lighting systems. Special emphasis is placed on strobeacon and flush lighting units.

1485. Discussion of Proceedings Paper 1480. (AT) Frank H. Gardner, Carlton H. Bascom on 1480.

1486. Professional Earnings and Satisfaction Survey of Civil Engineers: Report of the Junior Activities Committee, Kansas City Section, ASCE. (BD) A survey was undertaken by the Junior Activities Committee to reveal conditions of satisfaction with employment and salary within the membership of the Kansas City Section. The results have been plotted to indicate those conditions by age of employee, type of work, and by employer group.

1487. Engineers and Unions: Report of a Special Committee of the Junior Member Forum of the San Francisco Section, ASCE. (BD) The purpose of this report is to examine the relationship between engineers and unions, emphasizing the problem of unionization and collective bargaining for engineers.

1488. Circulating Water Systems of Steam Power Plants, by R. T. Richards. (PO) The need for reliability and economy in circulating water systems justifies careful hydraulic design. This paper examines some hydraulic features which require special attention.

1489. Computer Studies of Penstock and Governor Systems, by Eldo C. Koenig and Howard A. Knudtson. (PO) A high-speed electronic differential analyzer is used to solve equations describing dynamic characteristics of a hydroelectric generating system.

1490. Economic Advancement Objectives, Final Report of the Task Committee on Study of Economic Advancement Objectives of the Board of Direction. (BD) This report is submitted by the task committee which was established by the Board of Direction to make a complete new study and investigation as to what the Society can do to improve the economic status of its members.

1491. Tomorrow's Engineering Problems, by C. C. Furnas. (BD) The solutions of old problems frequently create new problems. The new engineering problems concern the use of our natural resources.

1492. Divided Flow Through a Divergent Inlet Conduit, by Stavros Tsakonas. (HY) This investigation is concerned with the determination of the characteristics of divided flow phenomena. Two models have been analytically and experimentally investigated.

1493. Abstracts and Index to Proceedings, Volume 83, (1957) (BD) A list of abstracts and a subject and author index have been prepared for all Proceedings Papers published in 1957; the numbers covered are 1136 to 1492. The subject headings used were taken from the names of the technical divisions of the Society; other headings were added when deemed necessary. By use of the author index, it is possible to trace all the discussions that a paper has received.

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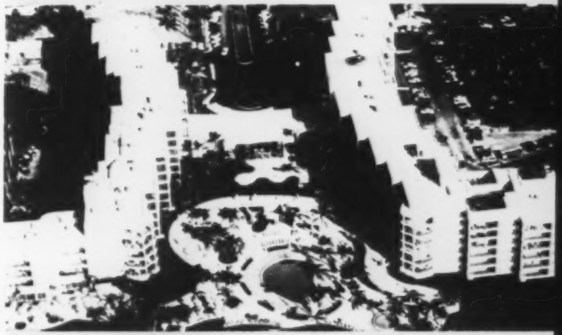

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